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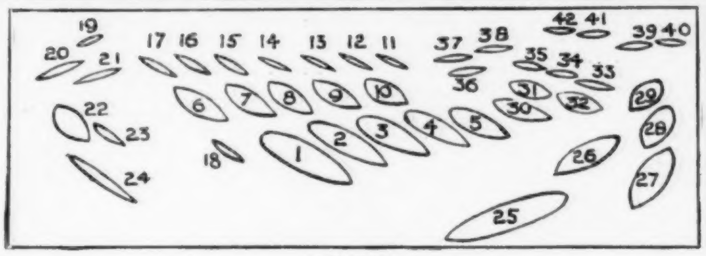
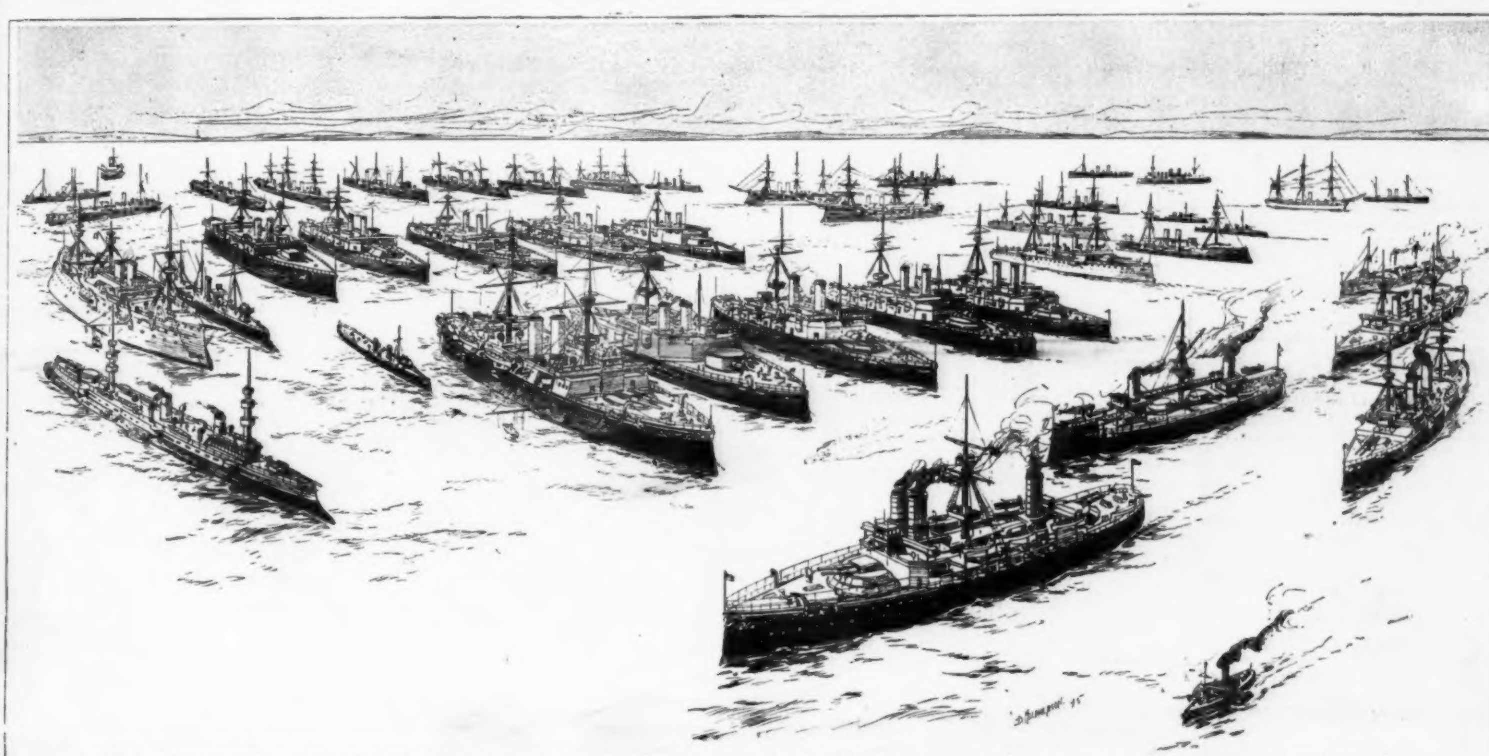
THE FLEETS IN THE LEVANT.

OF the fleets now watching the course of events in the Eastern Mediterranean the British fleet, which practically comprises all the ships belonging to the station, is by far the most powerful. It consists of ten first class battleships: two of the Royal Sovereign class, the Ramillies (Sir Michael Culme-Seymour's flagship) and the turret ship Hood; the extremely powerful trio the Trafalgar (Rear Admiral Domvile's flagship), the Nile, and the Barfleur; and the five "Admirals," the Anson, Howe, Camperdown, Rodney, and Collingwood, a much decried group, but, as it has been said, "of vessels that can steam fast and hit hard it is easy to be hypercritical." For present purposes these would seem to suffice, the more so that within the next six or eight weeks the smallest of our battleships in the Mediterranean—the Collingwood and the Trafalgar, which has been on the station for upward of six years, and needs overhauling at a home dockyard—are to be replaced by two sisterships of the Royal Sovereign, the Royal Oak and the Revenge. Our cruisers in the Levant are the Hawke, a first class cruiser of the very successful Royal Arthur and Edgar type, the second class cruisers Sybille and Cambrian (to which are to be added within the next fortnight the Astræa and the Forte) and the twelve year old Arethusa, the Barham, a third class cruiser of good repute as to her fitness for the duties assigned to her, the modern first class torpedo gunboat Dryad and the torpedo boat destroyer Ardent. The Dryad, it is stated, will probably be the vessel to be sent up the Dardanelles to Constantinople should the Sultan grant the Powers leave to have a second

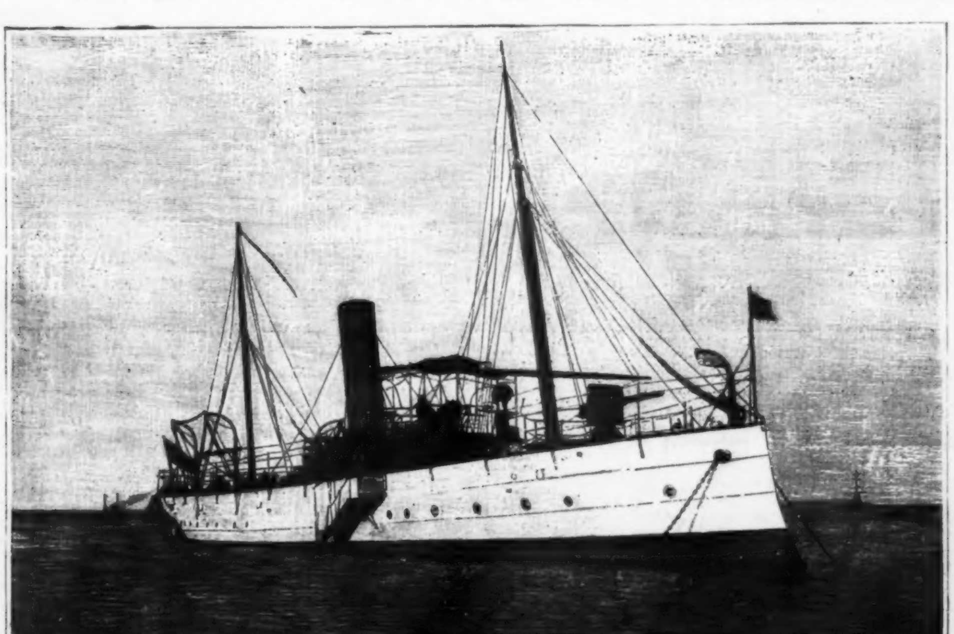


KEY PLAN.

BRITISH FLEET: 1. Ramillies. 2. Trafalgar. 3. Anson. 4. Hood. 5. Camperdown. 6. Barfleur. 7. Rodney. 8. Collingwood. 9. Howe. 10. Nile. 11. Dryad. 12. Vulcan. 13. Sybille. 14. Cambrian. 15. Barham. 16. Arethusa. 17. Hawke. 18. Ardent. FRENCH FLEET: 19. Vauban. 20. Fleche. 21. Linois. 22. Devastation. 23. Faucon. 24. Amiral Charner. ITALIAN FLEET: 25. Re Umberto. 26. Andrea Doria. 27. Stromboli. 28. Etruria. 29. Archimede. AUSTRIAN FLEET: 30. Kaiserin Elisabeth. 31. Donau. 32. Tegetthoff. 33. Meteor. 34. Sebenico. 35. Taurus. RUSSIAN FLEET: 36. Rurik. 37. Dimitri Donskoi. 38. Grosiastchy. GERMAN FLEET: 39. Moltke. 40. Lorelei. AMERICAN FLEET: 41 Minneapolis. 42. San Francisco.



THE GATHERING OF WARSHIPS IN THE EAST—THE INTERNATIONAL FLEETS DISPATCHED TO TURKISH WATERS.



THE WAR IN CUBA—THE SPANISH GUNBOAT VASCO NUÑEZ DE BALBOA.

FORTY TON SPANISH GUN LAUNCHES.

"guardship" in the Golden Horn. There we have already the small 460 ton special service vessel Imogene. Besides these has to be added the torpedo depot ship Vulcan. The British Mediterranean fleet has been in the Levant, now at Lemnos, then at Salonika, then again at Lemnos, ever since September.

Next in importance and force to the British fleet is the Italian squadron, which arrived at Smyrna on the 20th of November. It comprises the two modern first class battleships Re Umberto (flying the flag of the commander-in-chief, Vice-Admiral Accini) and Andrea Doria, the Stromboli, a second class cruiser, the Etruria, a third class cruiser, and the dispatch boat Archimede. In case of serious trouble arising a very powerful reinforcement has been got ready at Naples, and is now lying there coaled and prepared to put to sea. This comprises the battleships Lepanto, Francesco Morisini, and Ruggiero di Lauria, the cruiser Elba and the torpedo gunboats Calatafimi and Folgore, with, in addition, five torpedo boats.

The French squadron of five vessels arrived in the Piræus on November 17 and has since proceeded to Smyrna. It comprises the battleship Dévastation, the armored cruisers Vauban and Amiral Charner, the torpedo cruiser Faucon and the small third class protected cruiser Linois. The Linois has been detached to the Syrian coast (whither the British cruiser Arethusa has also gone), and her place in Rear Admiral de Maigret's squadron, it is stated, is to be taken by the torpedo gunboat Flèche, which has received sailing orders to that effect. The French squadron is that usually sent during the winter months to cruise in the Levant as a division of the French Mediterranean fleet in commission; it has only gone there this year a month earlier than usual. At Constantinople the French have for guardship already the dispatch vessel Lévrier.

The Austro-Hungarian squadron is under the command of Rear Admiral Seemann von Treuenwart and left Pola for the Levant on November 20. It is the regularly constituted Austro-Hungarian winter squadron and comprises the central battery armor clad Tegetthoff; the Kaiserin Elisabeth, a new second class cruiser; the third class composite cruiser Donau, and the Meteor and Sebenico torpedo gunboats. The Taurus, a special service vessel, is already at Constantinople as the Austrian guardship there.

The Russian Mediterranean squadron left Cronstadt a week ago and is now in English waters while repairs are being executed to one of the vessels. As at present constituted, it comprises the big first class armored cruiser Rurik, flying the flag of Rear Admiral Cologeras; the Dimitri Donskoi, a second class armored cruiser, and the Grosiastchy, a modern deck-plated gunboat. The Rurik and Dimitri Donskoi are for the moment at Portsmouth; the Grosiastchy at Gravesend refitting after her rough-weather passage across the North Sea. It should be borne in mind that within the last few days the first squadron of the Russian Black Sea fleet, comprising the powerful battleships Catherine II, Tchesme, Sinope, Twelve Apostles and George Pobyednosetz, with cruisers and small craft, after being put out of commission for the winter, have been, it is stated, recommissioned and ordered to hold themselves in readiness for service.

Germany has in Turkish waters already the training ship Moltke and the dispatch boat Lorelei, and to supplement these a battleship, the name of which has not yet been announced, is to leave Kiel shortly for the Levant.

The United States cruiser San Francisco, which for some time past has been lying at Marseilles, left there on November 16 for the Levant, where it is stated that Rear Admiral Selfridge will be joined from across the Atlantic by the cruiser Minneapolis. The Marblehead also may be added to the flag.—Daily Graphic, London.

SMALL SPANISH GUNBOATS.

THE Spanish government is making all possible haste to surround the island of Cuba with a cordon of armed boats, in the hope of preventing the landing of arms and men in aid of the rebels. The government is so pressed for money that only the smaller and cheaper class of boats can be furnished; but these, it is believed, will be sufficient to alarm and drive off the filibusters. One of our engravings shows the gunboat Vasco Nuñez de Balboa, 300 tons, carrying a rapid firing machine gun. The other engraving shows a couple of gun launches of 40 tons burden each, speed 11 miles per hour, each carrying a small gun. These boats have been hastily built in England. Our illustrations are from La Ilustracion Española.

[FROM A CUBAN CORRESPONDENT.]

THE WAR IN CUBA.

THE ESTIMATED FINANCIAL POSITION OF THE ISLAND OF CUBA FOR JUNE, 1896.

WE are now going to outline, with bare figures of undoubted veracity, the miserable financial position into which the once "Pearl of the Antilles" will be thrown by the end of June, 1896.

In 1868, when the first big war for independence began, Cuba possessed an immense wealth in sugar, tobacco, lumber, wax, etc., that were shipped throughout the world, and obtained such high prices that money was as abundant there as sand is on the shores. The total production amounted to $250,000,000 per year.

The war, like an appalling flood, destroyed, from 1868 to 1878, property, commerce and industry to the extent of over $3,000,000,000, including $850,000,000 spent by the Spanish government in war expenses.

This latter sum was partially obtained through war taxes and partially through public loans, of which $170,000,000 (still floating) recognized a yearly interest of 6 per cent. This interest, amounting to $10,200,000 yearly, was being collected up to March last out of the Havana Custom House rents, and at the rate of $33,333.33 per day, by the Banco Hispano Colonial, which institution is principally owned by the Spanish ministers and officials.

As already said, in 1868 the total production of Cuba amounted to $250,000,000. Let us see now to what it amounted in 1893, before the present war:

TOTAL PRODUCTION OF CUBA IN 1893.

Sugar, 800,000 tons, at 4 riales (say 50c.) per each 25 lb.	$32,000,000
Tobacco and other products	18,000,000
Total	$50,000,000

Let us now see the

TOTAL EXPENSES IN 1893.

Ordinary Budget:	
Officials of all sorts	$26,000,000
Municipal charges	10,000,000
Imports	40,000,000
War Budget:	
100,000 soldiers of all grades and 40 ships of all sorts	72,000,000
6 per cent. interest on $170,000,000	10,200,000
Total	$158,200,000

RESULT.

Amount of total expenses	$158,200,000
Amount of total production	50,000,000
Difference against Cuba	$108,200,000

These imposing figures show that the Cuban war is a perfect ruin for Spain, because, even taking off from Cuba its entire production, Spain will be short of $108,200,000 by the end of June next that she must borrow from somewhere else. And this is so perfectly true that she already borrowed from France some months ago $15,000,000, with security of her own soil, and is actually negotiating for a second loan, because the expenses of the war, as stated above, come to $6,000,000 per month, and the first $15,000,000 were swept away in two months and a half.

As the statements of "total production" and "total expenses" have been made under the basis of no destruction of crops or commerce, and it has occurred otherwise, we must now build new statements, deducting from the original ones the probable amount of production destroyed by the insurgents and the harm done to the imports, in order to come more closely to the true financial position for 1896.

We have figured the war expenses for one year to be $72,000,000, and we have not figured too much, because, during the ten years' war, $850,000,000, say $85,000,000 per year, were spent. But we have figured so less, because Marshal Campos is a straight man and officials must be more strict with him than what they were with generals like Valmaseda, Concha, Castillo, Blanco and others who were the commanders during the last big war. Some South American papers have figured this item as high as $93,000,000, but after having studied official sources and Havana papers, we consider it exaggerated. Therefore, our figures for this item must remain unchanged.

This observation once made, let us examine the items of the "total production." Sugar comes at the head, with $32,000,000, but as, unhappily for Cuba, a great amount of sugar cane has been destroyed and many sugar estates have been ordered by the Cuban leaders to stop all work and not grind a single pound of sugar, we must deduct from this item the amount that, more or less, has been destroyed, as well as that that will not be cropped.

Le Journal des Fabricants de Sucre stated, some six months ago, that Cuba would not produce over 400,000 tons of sugar in the crop of 1895–96, and some American papers have asserted that Cuba would only reach 600,000 tons in that period.

As our readers will understand, this is a point that cannot be ascertained with any certainty at all, and it is only by guess that we can calculate it, taking into consideration the data in our possession. Before the landing in Las Villas of Generals Rolof and Sanchez the damage done to the crop in the Oriental district and Camaguey amounted to 120,000 tons of sugar, and as the destruction in Las Villas and Matanzas amounts to very near 180,000 tons, the probable total amount of sugar that Cuba will be short in 1895–96 is 300 000 tons, thus reducing its total production to 500,000 tons, which, at 4 riales per arrobe, amounts to $20,000,000, and not $32,000,000, as in 1893–94.

Next comes the tobacco. It is true that the Vuelta Abajo district has suffered very little through the war, but the awful bad crop of 1894–95, that has turned out to be almost a failure, and the big storm that flooded that district a few months ago, will reduce its income to at least $3,000,000. As regards the "Gibara," "Magar," "Remedios," and "Camajuani" tobacco, the Cuban army has destroyed and stopped the crop entirely, and this amounts to pretty near $1,000,000.

Therefore, the tobacco production will be reduced $4,000,000.

As regards the other Cuban productions, it is very difficult to make any accurate calculation. Notwithstanding which, taking into account that the one district of Manzanillo produced in 1893 in the neighborhood of $1,015,000, as per the following statement:

Fine furniture lumber	$480,000
Granadilla wood	50,000
Fustete and other hard woods	65,000
Pillow fillers	15,000
Yarey straw, for hat making	65,000
Tobacco	280,000
Wax and honey	50,000
Tortoise shell and others	10,000
Total	$1,015,000

We can well calculate that the destruction of these products throughout the whole island amounts to about $3,000,000, which is a very fair calculation.

Our readers will notice in the statement "total expenses for 1893" an item that reads: "Imports, $40,000,000," which item represents the importations of foreign articles into Cuba during that year. This item must also be reduced to a great extent, for the following reasons:

The great losses that Cuba is sustaining through the destruction of her crops and the low prices for her productions have thrown a great many families into real misery, and forced the rest to live under a very economical footing. This, of course, has reduced the consumption of foreign goods to a great extent, because people limit their purchases to their most immediate wants only.

On the other hand, Cuban merchants have lost their credit abroad, no American or European merchant being willing to send them goods unless they pay cash for them, which system, though we admit is perfectly right, entirely curtails business.

Thus the Cuban merchants find themselves in a most disastrous condition, because, on one hand, they sell very little—only about 30 per cent. of what they usually sold before; and, on the other hand, in the majority of cases, they have to pay cash for what they import, and cannot collect right away what they formerly sold to their customers on credit.

This is the reason why almost no Cuban merchant can pay a draft on maturity, and asks always for an extension of time, and this is the reason why so many merchants, though they have not apparently failed, are apt to go to a failure, if urged by their foreign creditors to pay right away.

Under such circumstances, importations in Cuba will be reduced to a considerable extent during 1895–96, and we do not exaggerate in stating, after carefully considering all these facts, that such reduction will amount to $20,000,000. This refers exclusively to ordinary consumption, because, though there will be some demand for victuals, etc., for the Spanish troops, the increase has been taken already into account at time of calculating the war expenses, and is included in the $72,000,000.

Having made the foregoing explanations, we are now in a position to strike out the final statements of productions and expenses, as they will probably stand by the end of June, 1896:

TOTAL PRODUCTION FOR 1895–96.

Sugar—			
Customary production		$32,000,000	
Less destroyed and stopped		12,000,000	
Total for 1895–96			$20,000,000
Tobacco and other products—			
Customary production		$18,000,000	
Less destroyed and stopped:			
Vuelta Abajo	$3,000,000		
Remedios & Camajuani	1,000,000		
Other products	3,000,000	7,000,000	11,000,000
Total production for 1895–96			$31,000,000

TOTAL EXPENSES FOR 1895–96.

Ordinary Budget:		
Officials of all sorts		$26,000,000
Municipal charges		10,000,000
Imports	$40,000,000	
Less reduction, as stated.	20,000,000	20,000,000
War Budget:		
100,000 soldiers of all grades and 40 ships of all sorts		72,000,000
Cuban mortgaged debt—6 per cent. interest on $170,000,000		10,200,000
Total expenses for 1895–96		$138,200,000

Before establishing the difference between the revenues and the expenses, shown in the two statements above, we must call the attention of our readers to the important fact that the Cuban budgets have always, since many years ago, been short of an average amount of $5,000,000, and that, during 1895–96, owing to the depressing state of business and the destructive war that is being carried on, this difference will amount to $20,500,000, which is satisfactorily explained as follows:

The total production of Cuba will be $31,000,000; and, supposing the Spanish taxes amount to 50 per cent. of same, Spain cannot collect any more than $15,500,000, and as the ordinary budget amounts to $36,000,000, the deficit will be the $20,500,000 that we state.

Now that we have these data, let us form the final statement showing the final results:

FINAL RESULT.

Total amount of expenses		$138,200,000
Less total production		31,000,000
Difference against Cuba		$107,200,000
Distributed as follows:		
Spanish government:		
Deficit in ordinary budget		$20,500,000
War expenses		72,000,000
Interest on the $170,000,000		10,200,000
Loss sustained provisionally by Spain		$102,700,000
Cuban people:		
Expenses.		
Taxes paid to government	$15,500,000	
Amount of reduced imports	20,000,000	
Total payments	$35,500,000	
Less total production	31,000,000	
Loss sustained by Cuban people		4,500,000
Total Cuban deficit for 1895-96		$107,200,000

That is to say, that by the end of June, 1896, supposing that Cuba pays over the total amount of her production, she will still be owing $4,500,000 to foreign countries, and $102,700,000 to Spain, that will shove it over upon Cuba, in the same shape as she did the $170,000,000 mortgage loan at 6 per cent. per annum of the past war, and the $125,000,000 floating loan of her Santo Domingo, Marruecos, and other wars, some forty years ago.

Thus, Cuba will then be owing in total:

Floating loan	$125,000,000
Mortgage loan	170,000 000
New mortgage loan	102,700,000
In all	$397,700,000

Of which $272,700,000 will have to pay 6 per cent. per annum, that amounts to $16,362,000 a year only for interest on same.

How is Spain going to support this disastrous financial position? This is what we shall try to explain now.

We have granted that she may take just one-half of the total production of Cuba, and she cannot, nor will dare, to take a cent more, because no one can pay nor would pay more. For these reasons she has not yet enforced any extraordinary taxes in Cuba, nor will do it at all, at least while she may be able to borrow money from somewhere else.

Cuba has no coin of her own, Spanish coin being the only legal coin there, and therefore needs paper money more than any other country, because, not having any coin of her own, the Spanish coin flies away to Spain and abroad in uninterrupted currents, sometimes because exchange on Spain is higher than the six per cent. premium assigned in Cuba to such coin, and sometimes because people, afraid of the war, sell their properties and take their money away.

But as the smuggling and frauds committed everywhere by the Spanish officials and the eternal bad faith of the Spanish government spoils and discredits any transaction in which they may have the control, nobody in Cuba, with rare exceptions, wishes to see the greenbacks again, to remind them of the heavy losses they sustained during the past war, at the beginning of which they paid the Spanish bank notes at par, and at the end were paid at 149 per cent. discount, that is $100 gold for $249 greenbacks!

The issue, therefore, of any amount of bank notes would be followed by an immediate fall from their par value to 150 per cent., under which circumstances the Spanish government would suffer a great loss, because for each $100 emitted they would only get $40 in gold, and an issue of $15,000,000 would only produce $6,000,000 gold, and represent $15,000,000 for the future.

Therefore Spain has turned her anxious looks to all the pawnbrokers of the world, and, after great pains, France has supported her twice, but with the security of the Spanish soil alone.

And yet not a moment's reflection, not a kind word for the Cubans, not the slightest reform, no word of reason or justice, only the sword!

Where does Spain intend to go after these ways? To certain ruin, no doubt, and to the complete destruction of our poor sister Cuba, and our business transactions with her.

The reader will have easily noted, if he has attentively examined our statements, that the whole amount of transactions that the United States can expect from Cuba during 1895-96 will scarcely reach $30,000,000; which is, indeed, ruinous for our industry, agriculture, and commerce, because, if Cuba could be free and work for herself and contract for herself, our transactions with her would amount, within two years to come, to at least $150,000,000.

And the reasons are very obvious. The total production of Cuba would then probably amount to $100,000,000, and, as they would have to pay but very little taxes out of the reach of Spanish frauds, and be anxious to reconstruct their country, in order to place Cuba as the real "Pearl of the Antilles," their importations would amount to $50,000,000, at the very least, and we would be the ones to get all this import and export business of Cuba, amounting to five times as much as we get now!

As long as Cuba belongs to Spain, we shall have no chance for her commerce, because, as Spain sells all her products to the European countries, these ask Spain to grant them the preference in the Cuban market, to the damage of the United States, and Spain, in order to save her own products, sacrifices Cuba and the United States.

The last commercial treaty we had with Cuba proved that the foregoing assertions are perfectly right, because the damage done by the Spanish officials to the American merchants, in order to favor the European commerce, amounted to about $7,000,000 in one year!

Where is the commerce of the United States going to, if every European nation is daily snatching something out of our hands? We must study this question very earnestly, otherwise our commercial future is doubtful.

THE QUEEN ANNE'S RAILROAD.

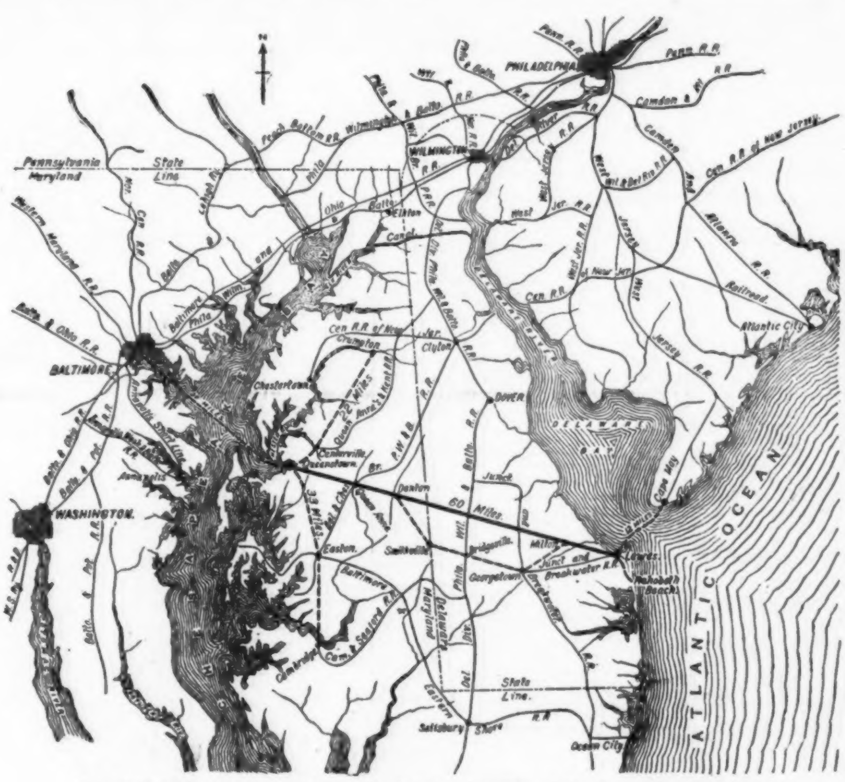
WHAT is known as the Queen Anne's Railroad is building across the Maryland-Delaware peninsula from Queenstown to Lewes. The first section of the road from Queenstown to Denton is being graded by W. C. Merritt, of Easton, Pa., and the eastern section is being surveyed by a party of engineers under the direction of Chief Engineer J. W. Troxel. Terminal facilities at Queenstown, consisting of a pier, train sheds and warehouses, are building, and it is expected that the western division of the road will be completed next spring and that the eastern division will be graded during the summer months of 1896.

The present plans of the Queen Anne's Railroad Company contemplate an "air line" across the peninsula 60 miles in length, and between Baltimore and Queenstown, 30 miles, steamers will be run connecting with the railroad at Queenstown. From this point also a branch line is proposed 22 miles long, through Centerville northward to Crumpton on the Chester River. Another branch, 33 miles long, running southward from Queenstown, will pass through Easton to Cambridge, in Dorchester County.

The project of building the Queen Anne's Railroad dates back to the early part of 1894. In that year several Baltimore capitalists, including Robert C. Davidson, president of the Baltimore Trust & Guarantee Company; Messrs. Middendorf, Oliver & Company, bankers; William H. Bosley and John S. Gittings, bankers; Bartlett S. Johnson and others, formed a stock company and secured an act from the Maryland Legislature granting a right to build a railroad connecting several of the county seats and larger towns of the eastern shore of Maryland. It was proposed then to build electric railroads, and that view of the enterprise did not change until the spring of 1895. In driving through the Maryland counties to inspect possible routes and in conversation with the thrifty farmers of the eastern shore, it was soon discovered that their minds were bent on a steam railroad, which would enable them to send their products to market in Baltimore in much less time than is now possible. The fact also suggested itself that Baltimore now has no direct communication with the seashore, and the project grew by degrees into an undertaking of much greater magnitude than was at first contemplated.

The company was reorganized last spring; capital was subscribed to the amount of $800,000; an enabling act and right of way were voted by the Delaware Legislature; and during the summer arrangements were completed to build a railroad from the Chesapeake Bay to the Atlantic Ocean, with branches and with terminal facilities of sufficient capacity to accommodate a large traffic. A construction company was organized July 31, of which Douglas Gordon is president, and contracts for constructing the pier at Queenstown and the western section of the railroad were awarded on August 20.

The chief consideration in building this railroad is the short route it will establish between Washington or Baltimore and the seashore. When it goes into operation these two cities will be 135 and 90 miles respectively from the beach. Under present arrangements it is impossible for Baltimoreans to visit the seashore either at Cape May or Ocean City, without spending a night on the way or in some hotel on the shore; but by means of this shortened route excursions could leave Washington or Baltimore in the morning, could reach the shore at Rehoboth Beach before 10 o'clock, and could go home in the evening. By a short sail of 12 miles it would be possible also to visit Cape May, going and returning the same day. It will be seen, therefore, that the Queen Anne's Railroad has in view the same end with reference to Baltimore that the Camden and Atlantic Railroad or the West Jersey line have accomplished for Philadelphia. —Railroad Gazette.



Map of Part of Maryland and Delaware, Showing Location of the Queen Anne's Railroad.

[Continued from SUPPLEMENT, No. 1042, page 16653.]

RAILWAY SIGNALING.*

By W. McC. GRAFTON, C.E., Signal Engineer, Pennsylvania Lines West of Pittsburg.

BLOCK SIGNALING.

BLOCK signaling may be considered under two heads, absolute block and permissive block; the latter is sometimes called time blocking. A block is the distance between two fixed signals on the same track and in the same direction; the distance between signals, or length of block, as it is called, varies according to the requirements of traffic. Out on the road, where the trains run fast, the blocks are long, but near the terminal stations the blocks are short, to enable the trains to close up and avoid delay.

Absolute blocking does not allow two trains to occupy any part of the same track between two block stations at the same time, and the trains are therefore geographically separated.

Permissive blocking is spacing trains by time; that is, when one train has passed into a block, or passed a block signal, another train is not allowed to enter the same block until a certain time limit is up; this is generally ten minutes after passenger trains and five minutes after freight trains. A combination of the two methods is used on some roads; that is, the absolute block is used to protect passenger trains and the permissive block for freight trains.

KINDS OF BLOCK SIGNALS.

Block signals are operated under three systems, as follows: Telegraph, controlled manual, and automatic. The telegraph block system is one in which the operators are at liberty to pull their signals clear at any time, and they can leave them in a clear position after a train has passed. The operations are directed by telegraph. When a train passes out of a block that operator notifies the operator in the tower in the rear that the block is clear. It is also the practice on some railroads for the operator to notify the operator in the tower in advance that a train has entered the block. This system depends entirely on the vigilance and accuracy of the operators to keep the trains separated.

The controlled manual system is operated under several different devices, but all use electricity for locking, releasing, etc. The simplest device is the electric slot. In this the operation is the same as in the telegraph block, but in addition there is an electric slot placed in the pipe line between the lever and the signal at each signal cabin. There are several different forms of "electric slot," but they all perform the same service; that is, when they are charged with electricity they hold the two ends of the pipe line together and the signal is pulled by the lever through the slot. When the electric current is cut out the slot will not hold, so that when the lever is pulled the slot will open, the ends of the pipe line separate, and the signal will remain in the danger position. The current is made from the rails through the slot; the operator pulls the signal clear as before, but when a train enters the block it will make a short circuit and cut the current off from the slot; the slot will open and allow the signal to gravitate to the danger position; the lever still being in the reverse position. The operator may throw the lever forward and back as often as he pleases, but he will not be able to pull the signal clear again until the last pair of wheels has passed out of the insulated section and the current is restored. This insulated section can be made any length that the person in charge deems desirable.

All the other devices for this kind of blocking are arranged with very elaborate and complicated electrical instruments in each tower, which are interconnected by line wires, and in some cases the electric slot is also introduced. An operator cannot clear his signal for a train without first asking permission from the tower ahead, and in some systems it requires the combined action of three towers before a clear signal can be given. I will explain the working of the Union Lock and Block System, which requires the combined action of two towers, and which will show the principles on which all operate. Towers A, B, and C control two blocks; a train starts from tower A; before A can give a clear signal he asks B to release him, which B does by pulling out a slide bar in the base of the block instrument. This action on the part of B is indicated to A by a small semaphore on A's block instrument going to the clear position. This partially establishes an electric circuit through a lock, and the circuit is completed by operator A pushing a button and at the same time pulling his signal clear. The train now enters block A, and upon passing signal A, automatically restores it to the danger position through an electric slot. When operator A now returns his lever to the normal position it becomes locked and he cannot reverse it except by going through the same operations as before. An important feature of the arrangement is the means employed to prevent operator B from releasing A a second time until the first train has passed out of the block. This is accomplished through the lifting of a plate on the block instrument that is marked "Free," "Train in Block," "Locked." When block A is entirely clear, the instrument at B exhibits the word "Free," which indicates that operator B may pull out his slide bar. In doing this the plate is raised to the position "Locked," and is so held until a train has entered the block at A, when the plate drops to the position "Train in Block," where it holds the slide bar locked until the entire train has passed out of the block, when the slide bar goes clear in and the word "Free" again shows on the plate. The failure of the electric current stops all operations and all signals go to the danger position.

The automatic system is one in which the train sets or releases the signals through the medium of the electric current. This is done by means of a circuit through the rails or by what is known as a track instrument

* From the Bulletin of the University of Wisconsin, No. 8.

used in connection with line wires. The rail circuit is decidedly the best on account of its simplicity and the more nearly perfect protection which it affords. There are three forms of signals used in connection with automatic blocking, the semaphore arm, the revolving banner, and the disk. The disk signal is the poorest of the three; it consists of a box shaped like a banjo, and for this reason is often called the banjo signal. Fig. 17. The box has an opening in front and rear filled with plain glass, and a lamp is placed at the back of the box throwing a white light through. Inside the box there is a movable disk made of red silk stretched over a light frame, which is arranged to drop in front of the opening to give the danger indication. The red banner in the day time or red light showing through

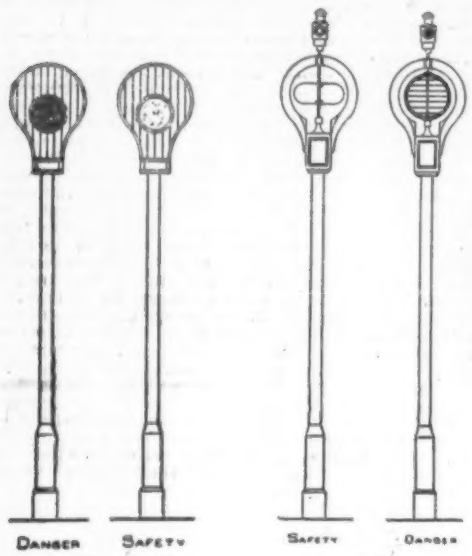


FIG. 17. FIG. 18.

the disk at night make the danger signal. This disk is raised by an electro-magnet, and when the circuit is broken the disk falls by gravity. In this form of signal the electric current not only controls the signal, but furnishes the power to operate it.

The banner signal, Fig. 18, revolves, making a quarter turn each time the electric current is broken or restored. The power to operate the signal is a weight, and the weight has to be wound up like a clock weight. The electric current controls it in very much the same manner as it controls the disk signal. The banner generally shows one shape for clear and another for danger; the two shapes being placed on a shaft at right angles to each other, so when a person looks at the face of one the edge of the other is toward him and he cannot see it. The lamp for a banner signal has four lenses, two opposite white lights and two red lights at ninety degrees from the white ones. As this signal makes a quarter turn it brings the danger shape and a red light into view, and the next quarter turn brings the clear shape and white light into view. As this signal shows the same front and back, it is the practice to put a shield over the back so that trains running in the opposite direction from that which the signal is intended to control will not read it for their signal.

The semaphore arm is the best signal of all, but it is only under the electro-pneumatic system that it can be operated automatically with any degree of success. As the name implies, this system requires a combination of electricity and compressed air for its operation; compressed air is the power that operates the signals and the electric current controls the power. In automatic signaling the circuits are generally arranged with an "overlap;" that is, when a train enters block A it throws the signal to danger, when it enters block B it throws the signal for that block to danger also, and still holds the signal at A to danger until the train is half way through block B, when the signal at A is released, but the signal at B is retained. In the electro-pneumatic system, home and distant signal arms are placed on each post, and a train holds the distant signal at caution for two blocks behind it, and by this means the enginemen have information in regard to the condition of the track for two blocks ahead. The blocks are located according to distance, grade of road, point of view, and also with relation to station stops.

LOCATION OF BLOCK SIGNALS.

In telegraph, and controlled manual blocking, the signals are placed at the stations or passing sidings, but in automatic blocking they are placed between stations to give better protection.

AUTOMATIC TIME SIGNALS.

There have been several devices arranged for automatic time signals. These are arrangements by means of which a train passing a signal sets it to danger, and after a certain number of minutes the signal of itself goes to the clear position. Signals of this style have never come into general use, as they are not desirable. Some of them are very ingeniously arranged, one of the best probably being the Fontaine Electric Time Signal, which consists of an indicator covering the segment of a circle and carrying numbers from 0 to 15, each figure representing a minute of time. There is an arm fastened in the center of the circle which points to the numbers. In the normal position the arm points to 15. When a train passes the signal it sets the arrow to 0 and the arm moves across the circle exactly like the minute hand of a clock, so that the arrow at any instant points to the number of minutes that have elapsed since the train passed. In this way a following train is informed just how long it has been (up to fifteen minutes, the limit of the instrument) since a train has passed the signal.

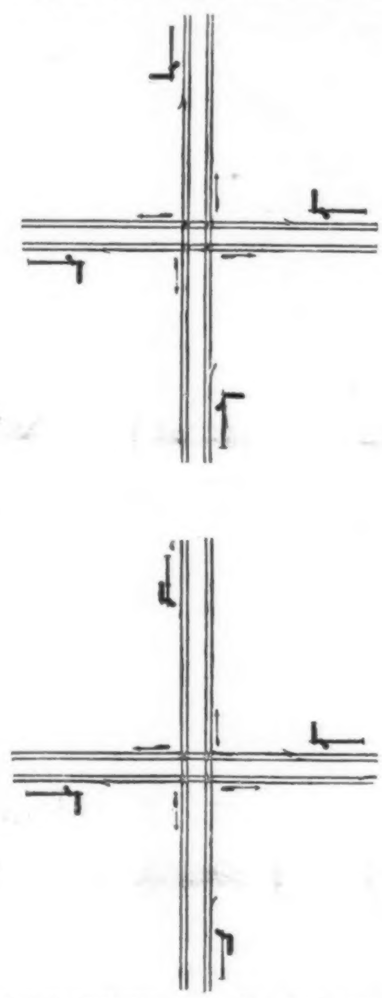
POWER PLANTS.

Interlocking machines that operate the switches, etc., through hand levers connected by pipe and wire connections are commonly called mechanical or manual machines, to distinguish them from the power plants, as they are called. In the latter plants the power for operating switches and signals is steam, applied through the medium of compressed air, water, or electricity. The first power plant built was a pneumatic machine, which was erected and put into service in 1876 at the south end of the "Y" leading into the Centennial tracks at West Philadelphia. A hydraulic machine was first put into service at Wellington, Ohio, in 1880. A hydro-pneumatic machine was first put into service at Bound Brook, New Jersey, in 1884. An electric machine was first put into service at Cincinnati, Ohio, in 1890. Finally, the last and best, in fact the only form of power machine that has ever given thoroughly good results, is the electro-pneumatic. This was first applied at the Jersey City terminal of the Pennsylvania Railroad in 1891, and since then the largest and most difficult places have been interlocked with this style of machine.

I will not explain any of these particular systems, as I understand that it is intended that each special system shall be explained by some one interested in that particular system.

APPLICATIONS OF INTERLOCKING—GRADE CROSSINGS.

Railroad crossings at grade furnish a great many places for interlocking, as the law of many States allows us to run trains over a crossing without stopping, provided it is properly interlocked, but requires a dead stop at all unsignaled crossings. The machine to do this work is just the same as for any other purpose, but in each track there is placed a "derail" on each side of the crossing. These derails are simply switches to throw the train off the track if the engineman disobeys the signals. The derails can all be open at the same time (Fig. 19), but those on conflicting tracks can-


FIGS. 19, 20.—Applications of interlocking. Grade crossings.

not be closed at the same time. When the derails on one road at the crossing are closed, those on the other road are locked in the open position (Fig. 20), and when a clear signal is given on one road trains can go over the crossing without fear of collision with any other train. In England derails are not used, but the enginemen are relied upon to obey the signals.

FONTAINE CROSSING.

In running over ordinary crossings at speed the crossing frogs are worn out very rapidly, and a number of devices have been patented for doing away with the open frogs and making a continuous rail crossing. The best of these is the Fontaine crossing, which consists of four turntables or posts, with a rail section on top; these posts are placed one at each corner of the crossing and are arranged to turn the rail section into line with whichever route is completed. The movement of the four corners is made with one lever and is worked very easily with the interlocking machine.

SIGNAL PROBLEMS OF TO-DAY.

I will now give you an outline of some of the problems we are contending with to-day.

WIRE COMPENSATORS.

We have no good wire compensator. The difficulty is to get a device that will counteract the expansion and contraction perfectly, and that will at the same time cease to compensate and become a fixed point when you start to move the signal, and that will allow the signal to go to danger if any of the connections break.

DETECTOR BARS.

The detector bar is one of the most important things connected with an interlocking plant, and yet it is the weakest in construction. It must be made as light as possible on account of the power which is required to operate it, since the centers on which the arms swing must be very little below the base of the rail, or dirt will wash around the arms, or water may freeze around them in winter and prevent their working.

Some bars have been arranged to work on a different principle, but no arrangements have given as good satisfaction as the one in present use, although it is expensive to maintain, on account of breakages. We want a light bar with ample strength and good motion, which will be easy to work.

FACING POINT LOCKS.

The facing point lock has one weak point. If the connection from a signal tower to a switch should break, the switch would not be moved when the switch lever is reversed, so that when the lock lever is reversed the switch would be locked up in the same hole as before, but the reversing of the switch lever would permit the giving of a signal which would be erroneous for the position of the switch. This is a very remote chance, but it has happened, and on our lines we have a staggered lock which is about perfected, and which will prevent an error of this kind. The switch will be locked in one position with one lock pin and in its other position with another lock pin; the holes in the lock bar will never register in front of the wrong lock pin; so, if the switch remains stationary when the switch lever is reversed, it will be

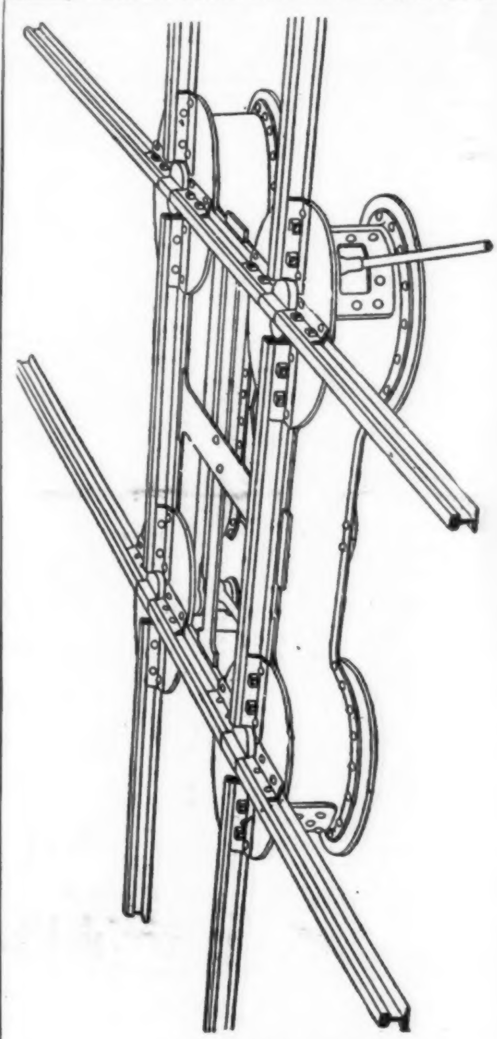


FIG. 21.—Fontaine crossing.

impossible to move the lock lever, which, in turn, makes it impossible to clear any signal.

COLOR FOR SEMAPHORE ARMS.

There is a great difference in the painting of the semaphore arm. As red is a danger and green a caution signal, it was the practice for years to paint the home signal arms red on the face and the distant signal arms green on the face, and both white on the back. Some, however, were painted with a white or a black band across the face. The Pennsylvania lines west of Pittsburg were the first to change the painting of their arms, when, in 1889, they adopted yellow for the face of all arms and white for the back, with a black band across both front and back. As color has no significance in a position signal, yellow was chosen as being the most durable color, and also as one that would show out clear against the greatest variety of backgrounds. A committee of the American Railway Association once recommended red for home and yellow for distant signals, and some roads follow that practice, and there is no uniformity in painting signals.

COLORS FOR NIGHT SIGNALS.

The question that is receiving the most consideration to-day is the color for night signals. With few exceptions, the practice to-day is to use red for danger, green for caution and white for safety, but there is a strong effort being made to change this so as to do away with white for safety and to use green in its place. There are two reasons for desiring to make this

change: (1) that there are so many white lights used around cities and towns that the engineman is apt to mistake one of these lights for a safety signal; (2) which I think the best reason, the colored glass used in the spectacle frame of the semaphore arm may be broken out and the white light from the lamp will then show through the spectacle frame, giving a safety signal when the signal arm is at danger. If the use of a white light for signal purposes is done away with and red is used for danger and green for safety, it leaves us without any colored light for a caution signal, since there are only three primary colors—red, green and blue—and a kerosene lamp cannot be obtained which will give a strong enough blue light to answer for a signal. The roads that have adopted green for safety use a combination of red and green for caution. The American Railway Association has this question under discussion now, and has asked the different roads to vote on it, with a view to having one standard adopted for the entire country. I think our present method is the best, red for danger, white for safety and green for caution, as the chance for an engineman to mistake some colored light in a city or town for his signal is about as great as the chance that he will mistake some other than his own white light for his signal. We are experimenting now with some colored glass with a wire mesh embedded in it, so that the glass may be completely shattered, but the wire still holds enough glass in the frame to show the color plainly. This avoids difficulty from broken glasses, and the few cases of broken glass that we have had heretofore will be discounted so as to make the color signal about as safe as frail humanity can make anything.

ILLUMINATED BLADES.

There has been some effort made to get a position signal for night, but so far nothing satisfactory has been accomplished. One effort in this direction was a semaphore arm shaped on the line of a parabolic curve. The lamp was hung in front of the arm so as to throw the light on the face of the arm. Another was a semaphore arm with the lamp hung back of the arm and on the same center (Fig. 22). There was a long, narrow slot cut in the face of the arm and filled with plain glass, while on the back of the arm there was a corrugated reflector. The light from the lamp was thrown into this reflector the full length of the arm, showing in any position of the arm a long strip of light.

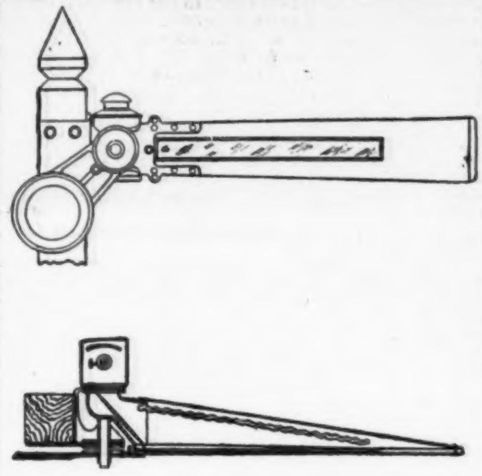


FIG. 22.

THE SILVER AND BRASS SIGN INDUSTRY.

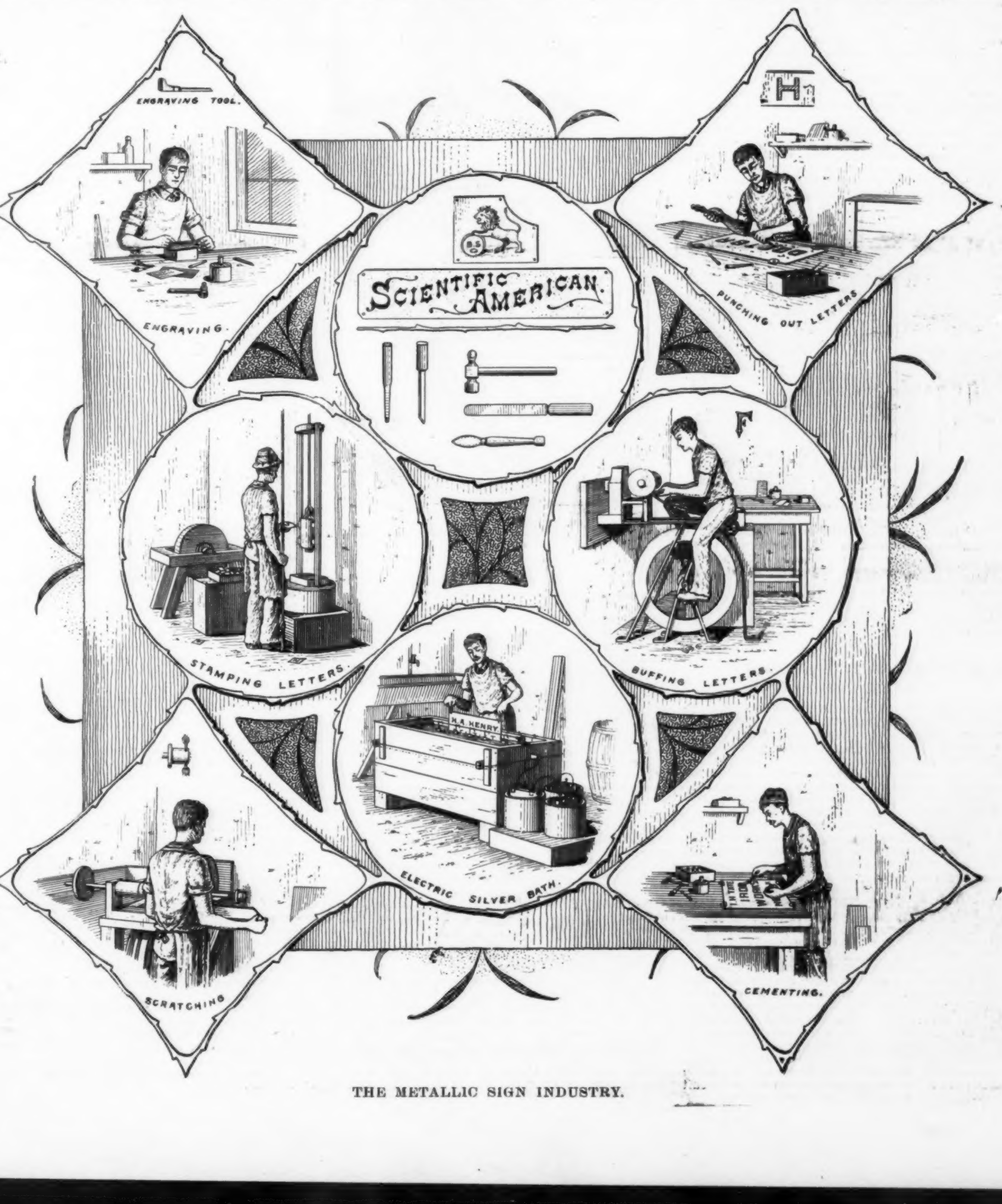
A GREAT number of the small metal signs placed in the doorways of business houses are made of sheet brass. The lettering or design is first drawn in outline on the surface and then cut into the sheet a certain depth and then filled with a black or red cement, which soon becomes quite hard. The signs to be silvered are placed in an electric bath composed of cyanide of silver and cyanide of potassium and left for a number of hours, the signs when withdrawn being coated with silver, after which they pass through a process of washing, scratching, cementing and burnishing. The brass is bought in sheets, according to the size wanted. The metal is about one-eighth of an inch in thickness and costs on an average about 42 cents per pound.

The lettering is cut into the metal about one-sixteenth of an inch in depth, the metal being cut out by hand by means of different sized steel punches or chisels. It requires about three hours' labor for a man to cut out the letters of a sign measuring about 24 × 30 inches. Very small signs are engraved with tools similar to those used by wood engravers. The cement which the letters are filled in with is composed of either vermilion and white lead or lamp black and white lead, the two ingredients being mixed thoroughly together with a little kerosene oil, forming a putty or cement which is pressed into the letters with a double-edged steel knife, the operation taking for a sign 24 × 30 inches about 1½ hours.

After the cement is quite hard the sign is polished by rubbing the surface with dry drop black and a soft rag, the operation taking about 1½ hours.

The signs to be silvered are placed in a bath of cyanide of silver and potassium before being cemented. The bath is composed of about one-half cyanide of silver and one-half cyanide of potassium. The tub which holds the solution is about 7 feet in length, about 3 feet in depth and about 18 inches in width. The plating is performed by means of two copper wires running from an electric battery, one wire passing across the center of the tub at the top, from which are hung a number of silver bars or strips, the other wire passing around the sides of the tub, to which are hung the signs to be plated. Small copper wires connect the bars of silver to the center wire, the electric current from which causes the bars, which hang down into the bath about from 10 to 12 inches, to dissolve.

The signs are connected in the same manner to the other wire, the current of which draws the dissolved silver from the bars to the signs, causing it to adhere to



THE METALLIC SIGN INDUSTRY.

the metal. The strips of silver are about 12 inches in length and about 1 inch in width. Good plating requires about 18 pennyweights of silver to the square foot. The signs are left in the bath about 8 hours and then thoroughly washed with water, after which they are scratched or frosted. This operation is performed by means of a revolving wheel, connected to which are a number of very fine wires, which, when the operator holds the sign in position, scratches the surface. This scratch wheel or brush, which travels at the rate of about 3,000 revolutions per minute, gives the surface of the sign a frosted appearance. After the scratching process it is cemented and the edges burnished, the burnishing being performed by means of a steel oval shaped tool and soft soap, the tool, being rubbed back and forth over the surface, giving it a finely polished appearance, it taking about two hours to burnish a square foot. Single letters are stamped by means of a drop press. The steel upper die which contains the raised letter is locked in the bottom of the drop weight. The bottom die which is sunk is made of spelter. The drop weight, which may weigh from 5 to 20 pounds, is raised and lowered by means of a rope which passes over a pulley above and is worked by the foot of the operator. A piece of the metal is placed over the lower die, and by the operator raising his foot suddenly the weight is dropped, the upper die pressing the metal into the spelter die, which shapes out the letter.

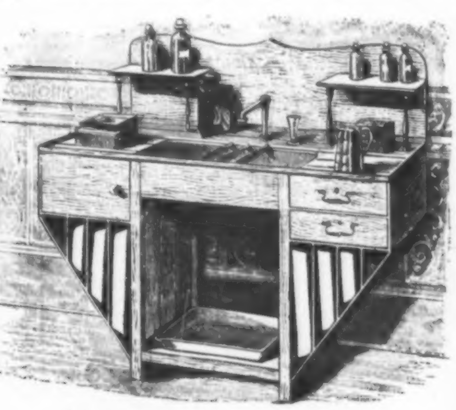
A good hand can press out about two letters per minute. The letters are then trimmed by means of a screw cutting press and then buffed. This is performed by holding the letters against two revolving wheels made of circular pieces of unbleached canton flannel. The wheels are about 8 inches in diameter and contain about 300 sheets each, and, when in motion, are about 1½ inches in thickness. The wheels travel at the rate of about 1,500 revolutions per minute, fine rouge being used on one wheel and coarse on the other, it requiring about two seconds to buff a letter.

The sketches were taken from the plant of Trevor F. Jones & Company, New York City.

DEVELOPING TABLES.

WE present engravings of two developing tables, for which we are indebted to the Belgian photographic journal Lux. The wooden developing table consists of a lead sink with faucet, shelves for bottles, drawers and a rack for pans. Such an outfit could be easily made at little expense by any cabinet maker.

The portable developing table is especially adapted for use in the country where running water cannot be obtained. It consists of a japanned iron table provided with shelves. At the top is the ruby lantern. On each side are shelves for holding the bottles of chemicals. Directly below the lantern is a tank filled with water. On one side is a rack for trays, on the other space to store graduates, etc. The sink consists of an open grating over a large pan which is capable of holding considerable waste water, which is drawn off into a pail below with the aid of a rubber tube. On each side are drawers and below are shelves for the fixing and alum baths, etc.



WOODEN DEVELOPING TABLE.

PORTABLE JAPANNED IRON DEVELOPING TABLE.

BRONZE PRINTING COLORS.

By A. M. GARANCK.

MANY attempts have been made to get metallic effects on cloth in clear and well defined designs, but hitherto with little success. Metals or alloys printed on in a fine powder, with some vehicle such as gum, invariably clog the engraved lines of the roller, and not only give muzzy and blurred designs, but travel on to the plain part of the roller and sparkle out from what should be the ground color of the cloth. No method has ever been hit upon of overcoming this difficulty, although the attainment of the object is tempting enough. The nearest approach to perfection that I have seen are the bronze colors ready mixed sent out in boxes by a Nuremberg manufacturer, but even these do not give complete sharpness in design. This manufacturer recommends deep lines in the rollers, "the deeper the engraving, the more beautiful and more permanent will be the effect," and it looks probable that improvement in definiteness of design is to be sought for in a special form of machine or a special method of application. The uni-effects in bronze colors are obtained satisfactorily enough.

It would be an error to suppose that a metal has merely to be reduced to a fine powder to serve as a bronze color, although O'Neill seems to say that this is all that is necessary. It is absolutely requisite for this that the powder should be formed of fine scales, which must not only be minute but at the same time flattened and brilliant. These two conditions are not easy to associate. Gold, for instance, may be precipitated from its salts in a finely divided state by suitable reagents, but it falls down in the form of a brown powder without any metallic reflect. If a little of this powder be ground heavily in an agate mortar, the metallic luster shows at once, but the particles of powder have become agglomerated and the scales are too large for any practical use. Gold leaf, however, gives a very fine and usable product when it is ground up with gummy water, and, according to Guignet, it was the effort of a native of Furth, near Nuremberg, where much "Dutch gold" is made, to imitate this with the base metal that led to the invention of bronze colors in powder in 1750. Nowadays a wide range of shade is procurable in these colors, and they are largely used in every sort of painting, in paper staining, and in tissue printing.

Nearly all the bronze colors are made from the different alloys rolled out into fine sheets and often beaten with mallets between pieces of skin, as gold is treated. The sheets are put over a fine sieve, and rubbed through the holes with a wire brush. The fine dust thus obtained is ground up in gum water, washed in hot water to remove any dirt, and finally dried at a low temperature. The shade of the bronze is varied, not only by the proportions of the alloy, but by heating them in the air or exposing them to sulphurous vapors. Fine coats of oxides in the former case, of sulphides in the latter case, are formed, which take very beautiful hues, and the process is stopped at the exact moment the required shade makes its appearance.

For light shades the proportion of the alloy is 83 parts of copper to 17 parts of zinc; for red shades the proportions vary between 90 to 94 of copper to from 10 to 6 of zinc. The fiery copper red tint is obtained by using pure copper. Copper precipitated from its solutions with iron or zinc is always mixed with small crystals of its salts, and therefore lacks brilliance. Even the metallic precipitate got by plunging a blade of steel tightly wound round with cotton cloth into a solution of copper sulphate will not do in bronze color making. When, however, cupric oxide is heated in paraffin vapor the metal is obtained in fine and uniformly tinted scales. When the paraffin vapor contains traces of sulphurous fumes, the copper takes rainbow tints, a fact which possibly may be taken advantage of in actual manufacture. Argentine or white bronze is simply tin powder. This is got by shaking up granulated tin in a box, the inside of which has first been rubbed over with chalk. Aluminum in a fine powder has also been used since the metal grew cheap.

Less decided metallic effects but in some cases clearer outlines can be got with ground materials used as pigment colors, and also with dyewood lakes. The mosaic gold (Musivgold), which was used in the decoration of Solomon's Temple, is said to have been simply bisulphide of tin, and if so, this is a pretty ancient example of a mineral bronze color. It has, however, been supplanted by yellow bronze colors, not so durable but costing less. Guignet suggests that, as a yellow bronze, iodide of lead might be used. It is easy to obtain in brilliant golden scales by dissolving it in boiling water and allowing it to cool. It is used already to some extent as a yellow pigment, but it has the double fault of all lead colors of being poisonous and of turning black in the sulphur fumes which are inevitable in these days of coal fires and coal gas. It is expensive, moreover, and not very fast to light. As a lilac or violet bronze, anhydrous sesqui-chloride of chrome has been suggested. It is got by passing chlorine over a mixture of chrome oxide and charcoal at a red heat. There must be no proto-chloride of chrome in the resulting mass, otherwise it will dissolve in water with the greatest ease. Properly prepared it is in metallic scales of a beautiful peach blossom shade. A green bronze is got by decomposing bichromate of potash at a red heat. The neutral chromate of potash is dissolved out of the resultant mass with boiling water, and may be used in making chrome yellows. The remainder is in fine scales of metallic green, and is an exceptionally permanent color. The tungsten or wolfram bronzes are simply double tungstates; for instance, tungstate of tungsten and sodium. This forms in brilliant golden crystals, while the corresponding potassium salt is in violet needles with a coppery luster. A compound with a lithium base discovered by Scheibler has a beautiful steel blue appearance. Some of the salts of titanium crystallize in scales of scintillating metallic luster, and neither of these metals is too scarce to be employed in commerce nowadays.

A large number of organic products, natural and artificial, have a metallic luster, but the greater part of them are soluble in water, and cannot therefore be used as bronze colors. In paper staining a few coal tar colors protected by a coat of varnish are thus employed, however, to get metallic effects. Dyewood lakes also form vegetable bronze colors. Possibly any of the dyewoods could be used, but logwood and the redwoods are usually taken for the purpose. The process is much the same with any of the woods. The extract or boiled decoction is treated with a little carbolic acid and allowed to stand for some weeks. The supernatant liquor, which should then be quite clear, is siphoned off, heated, mixed with alum in the proportion of about one-fifth of the weight of the original redwood, and left another week. A precipitate falls down, and is filtered off, washed, and either completely dried or left as a thick paste. This is the color, and can be applied with a brush when about 15 per cent. of strong gum water is added to it. A gold bronze is made by dissolving soap over a water bath in the least possible quantity of water; then add melted white wax in bulk equal to the soap solution, and dilute the hot mixture with water, which when cold should be of the consistency of thick turpentine; then the redwood paste is added. This mixture forms a paint which may be used on wood, paper, or leather, and after application, drying, and polishing gives a beautiful gold bronze. It may be varnished over with turpentine to make the color waterproof.

The same process is exactly followed with logwood. Treated with alum, the extract gives a light gold bronze; with a tin salt, a dark brown precipitate falls down. A mixture of alum with a tin salt in varying proportions will give all intermediate shades. The light gold got with alum can be intensified by adding bichromate of potash, but great care must be taken to use no excess of bichromate, otherwise the color will be too dark for a bronze. The bichromate added when the two salts are used together modifies the shade and increases the range at the disposition of the manufacturer. The color of the precipitate also depends upon the strength of the extract. The best method is to add a weak solution of bichromate little by little to the extract at the same time as the alum, making up trial samples of the color with soap and wax until the shade shows that enough bichromate has been added.

One of the most notable of the metallic colors sent out by the German manufacturer already mentioned is a splendid emerald, but how it is obtained I am unable to surmise. It is, however, shown in fairly well defined sprigs and leaves on a white cotton ground.—The Dyer and Calico Printer.

NOVELTIES IN THE GAS LIGHTING FIELD.*

DURING the past few months we have had the discovery of new elements in the air, the industrial production of calcium carbide and acetylene, the discovery of great quantities of the rare earths for mantles, the synthesis of lighting gas, or its carburation by benzol.

Argon.—The discovery of argon, when first declared, awakened considerable doubt, for so many investigators have been at work at the atmosphere for so many years. The ordinary impurities of the air were all well known; its microbes, its ozone, had all been examined; but there was no thought of there being a new element in the air which had not been found in any mineral. One observed fact had, however, put the discoverers on the track. Lord Rayleigh had found that nitrogen from the atmosphere was always heavier than nitrogen from pure nitrogen compounds. This led to the suspicion that in the atmosphere the nitrogen was really a mixture of pure nitrogen with a heavier gas; and this gas was discovered on absorbing atmospheric nitrogen with red-hot magnesium or lithium. A residue was left unabsorbed, which was a heavier gas than nitrogen; and this gas is, like nitrogen, so inert that it had always been reckoned as nitrogen in all analyses. This gas gives, in a Geissler tube, a light whose spectrum is quite different from that of pure nitrogen—it is more soluble in water. It cannot yet be said what part, if any, argon plays in a flame. It seems clear now that argon is not an allotropic modification of nitrogen, but is a genuine new element.

It cannot be called a rare element, for though it makes up only 1 per cent. of the atmosphere, its total quantity is immense. Nitrogen does not exist in any primitive rocks, and is, as a rule, only found at all in minerals (such as coal) where these have been derived from some form of living being; but, most curiously, some few minerals, especially of the uranium ore order, contain both nitrogen and argon, and give them out at a red heat, or upon treatment with acids. The gas given out had hitherto always been looked upon as nitrogen. But more than that, this gas contains another gaseous element, helium, which had never been found upon the earth, and was only known as a constituent of the atmosphere of the sun.

Rare Earths.—Ten years ago these oxides were hardly to be seen, except as chemical curiosities, and the price of thorium was about 37 cents a grain. The minerals containing them were first investigated about the end of last century, and were mostly from Sweden. In cerite Mosander found ceria; then in the same mineral he discovered lanthania, and afterward didymia; and afterward a considerable number of these oxides were discovered. Their property of brilliant incandescence, when heated, has been very long known; but it was not of any particular interest until Auer von Welsbach took it up. When he had done so the minerals were found to be much more widely spread than had been supposed. Whole geological forma-

* Abstracted by the Gas World, from an article by Dr H. Bunte, of Karlsruhe.

tions are found, in America, to contain them in small quantity.

Monazite, which is a phosphate of cerium and lanthanum containing 2 to 4 per cent. of thoria, has been found in quantity in Connecticut, in South Carolina, in Brazil, in the Ural Mountains and in Australia; and, curiously, it is mostly associated with the neighborhood of gold, so that monazite sand, which is very heavy, was quite well known to gold dust washers. But in August of last year 65 tons of this sand was obtained in the United States alone; and the output is increasing. At first all went to the Welsbach companies, but now there are other works which prepare the pure salts, and thus there is a market which regulates the prices. The prices of monazite have come down from 20 or 25 cents to 6 or 6½ cents per pound, and a firm in Amsterdam offers to supply 20,000 tons per annum at 9 cents per pound. At this price the mere value of the thoria in a Welsbach hood would be 0·036 cent; the cost comes in in the difficulty of working up the mineral, and therefore we cannot look for any reduction in price through cheapening of the raw material. Then, is there enough raw material in sight? There would seem to be, for the quantity which the Amsterdam firm is ready to supply per annum would make 1,200,000,000 Welsbach mantles a year, which seems more than ample. We need at present smaller Welsbachs of say 20 candle power. These, with penny-in-the-slot meters, would give a very cheap light, and would keep down the rising price of petroleum.

In spirit Welsbach lamps, for 20 to 22 candles, the consumption per hour is about 1,200 grains of spirit of 96 per cent.; and at the price [in Germany] of 37 cents per gallon, this comes to about 0·0576 cent per hour. The lamp still needs improvement; but in it a blue spirit vapor flame acts upon an ordinary Welsbach hood. Externally it looks like an ordinary petroleum lamp, and the fittings can be screwed into the head of any such lamp. Naphtha vapor lamps and benzene vapor lamps are also made for the same purpose.

Acetylene.—[History given.] The Neuhausen-on-the-Rhine works and the Bitterfield works both supply carbides at 12 cents a kilogramme ($127.75 a ton). The calcium carbide is sealed up in cases of 11 to 22 pounds; the aluminum carbide, which is a powder, and is much less easily decomposable by moisture, does not need such precautions. The commercial carbide contains from 50 to 65 per cent. of pure carbide, and in all calculations this ought to be kept in view. There is in the flame no blue whatever, the gas burns at once, and this is the basis of Professor Lewes' theory [explained]. The gas can be very readily condensed, and the Mannheim Chemical Industry Company is now supplying it in the liquid form in steel cylinders. The light in this form is not very cheap, but is beautiful. For enrichment the prices of carbide and acetylene are too high; and the advantages of non-condensibility, which acetylene possesses, are somewhat too remote.

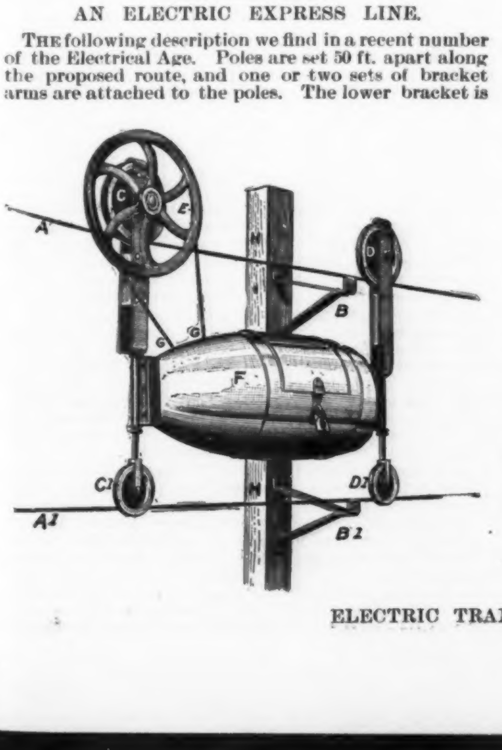
Benzol Enrichment.—This is now a good deal employed in England and in France, as well as in Germany. It is the natural means for enriching coal gas, and, at present prices, it is still the cheapest, for it is cheaper to benzol-enrich gas from poor coal than it is to make rich gas direct. Experiments have lately been made, on the large scale, in Munich, and by the Dessau Company. In Munich, the whole enrichment is now being done by means of benzol, for they find benzol cheaper to use than cannel; there is more gas to the ton, and air purification is facilitated (1 per cent.) There now seems little fear of a rise in the price of benzol. The 1 per cent. of air does not now lower the lighting power, while the purifiers last longer. The benzol is steam heated to 77° F., and 21·5 lb. of benzol are evaporated per hour into about 25,000 cubic feet of gas. At 55·4° F. some 7¼ lb. of benzol would evaporate per hour; and at 118·4° F., about 110 lb.; so that the supply of benzol to the gas is under prompt and ready control, which is not the least of the advantages of the process. Herr Schilling gives the above results, and says that no difficulties or disadvantages have been met with. They may be got into the gas by the most various methods; the main thing to see to is the quality of the benzol. Fifty per cent. benzol, half of which evaporates below 212° F., generally contains too much toluol, etc.; the right kind to use is 99 per cent. benzol, which is, after all, not very much dearer than the other. The quality of the benzol supplied should be kept under observation by means of simple distillation tests.

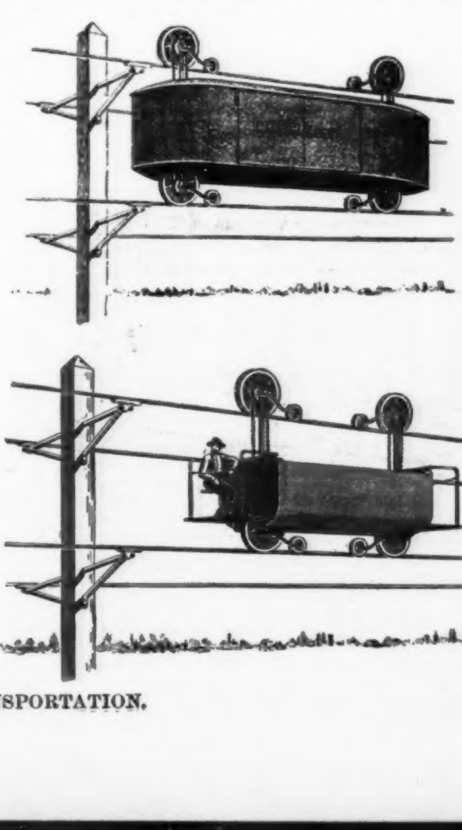
AN ELECTRIC EXPRESS LINE.

THE following description we find in a recent number of the Electrical Age. Poles are set 50 ft. apart along the proposed route, and one or two sets of bracket arms are attached to the poles. The lower bracket is placed 21 ft. or more from the ground, so that the lower cable shall in no way interfere with the public traffic, and the upper bracket is placed at a suitable distance above that. Cables are then strung from bracket to bracket, and the cars run between these. Due preparation has been made for switching cars from one line to the other, and the mechanical workings of the same have been thoroughly tested. A, A¹ represents the cables, A being the positive and A¹ the negative, secured to brackets, B and B¹, which are fastened to pole HH. C,C¹, D,D¹ represent grooved wheels running upon cables, A, A¹. The current passes from wheels, C, C¹, through frame to motor situated in car, F, but not shown in cut. GG represents belt running from motor to wheel, E, which is pinioned to wheel, C.

The motors are of the proper horse power, being amply powerful for any work that may be required of them. The plan of operation is simple. The upper and lower cables are connected with the source of electricity, the upper acting as the positive and the lower as the negative, and from these the current passes to the motor situated in the car.

For a general example of the working of the system let A, B, C, D, E and F represent the several stations on the line of the proposed road, A and F being the terminal points and centers of trade dealing with the people leaving at the stations, B, C, D and E. Suppose the car to be loaded at A with packages for B, D, and F, E and C on this trip having none. The man in charge at A, when the car is loaded, turns on the current and starts it off, at the same time pressing a button which rings up the agent at B, letting him know that the car is on the way and has some packages for his station. The agent at B then turns on a switch which cuts off the current from a section directly in front of his station, thus bringing the car to a stop when it reaches this point. After B has removed the packages intended for him he notices that the next stop is to be made at D, and starts the car on again, at the same time ringing up the man at D. In this way, C having no packages is not disturbed, nor is any time lost by the car stopping uselessly. The men at D and E follow the same plan, and thus it goes on to F.





ELECTRIC TRANSPORTATION.

GALVANOTROPISM OF TADPOLES.

THE above is the title of a lecture in electro-physiology recently delivered by Dr. A. Waller, M.D., F.R.S., lecturer on physiology in St. Mary's Hospital Medical School, London.

In illustration of his subject the lecturer had provided a trough of water, the two ends of which consisted of metal plates which served to pass a galvanic current through the water. The subjects of the experiment, a couple of tadpoles, were placed in the trough, and, upon turning on the current, it was seen that they were thrown into a state of violent agitation (Fig. 1), which continued until they finally settled down near the positive plate, with the head pointing to the anode and the body lying in the line of the current, as in Fig. 2. Upon reversing the current the tadpoles manifested the same uneasiness, swimming restlessly about the trough and finally settling down, head to anode, as before, the anode now being the left hand plate. Occasionally, as in Fig. 3, the tadpoles would swim to opposite plates, always, however, preserving a position parallel to the direction of the current. In this latter case, however, there would be this difference, that the tadpole lying head to anode would be perfectly still, whereas the one that lay head to cathode would wag its tail, indicating that it was not so much at ease as the other. This was further proved by reversing the current while they lay in opposite directions, the effect of which was that the moving tadpole became instantly still and the other restless.

The lecturer likened the effect to that produced on a cat by stroking the "right" or the "wrong" way. Evidently the "right" way for the current to pass through the tadpole for its general delectation is from head to tail.

The third experiment, Fig. 4, serves to show that sensibility to the galvanic current involves the presence of the spinal cord. It contains two tadpole tails, which have been so cut off that the upper one contains a part of the spinal cord, while the lower one does not.

The upper tail, containing a portion of the spinal cord, responds to electric excitation exactly as did the live tadpoles; oscillating when the current passes from tip to head, and remaining quiet when it passes from head to tip. The lower tail is not affected by the current in either direction.

The above curious phenomena are defined as "a reflex adjustment of the animal to its environment effected through the agency of the nervous system."

The action of the electric current upon the lowest forms of animal life is directly the opposite of that observed upon differentiated muscle and nerve. "In general the orientation of infusoria is such that they arrange themselves longitudinally in the lines of current, with their anterior ends toward the cathode, and their swimming movements, if any, in that direction."

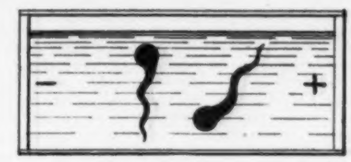


FIG. 1.

FIG. 2.

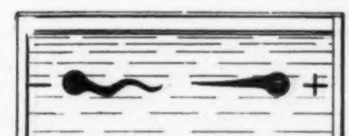


FIG. 3.

FIG. 4.

Roux, in experimenting on fertilized frogs' eggs, noticed that under a strong current each egg shows a division into three zones—two dark polar areas separated by a light equatorial zone—and the eggs arrange themselves so that the light equatorial stripes lie at right angles to the lines of current.

Ciliated infusoria swim with the current; flagellata against it. "It is difficult to resist laughing," says the lecturer in his concluding experiment, "when one has under one's eyes the spectacle of a galvanic bath such as this, containing a mixture of ciliated and flagellated protozoa. In the absence of any electrical current, they are swimming about in all directions, intermingling in the most friendly manner. Make the current, and two armies, so to speak, assemble themselves on the two banks; ciliata to the cathode, flagellata to the anode! appears to have been their mot d'ordre; and now, if we reverse the current, the two armies put themselves in motion and appear as if precipitating themselves on each other; but no disaster happens. The opposing crowds slip through each other and reassemble at the pole which they respectively affect."

A NEW SPECTRAL PHOTOMETER.

By A. KOENIG.

BETWEEN the collimator tube, which has the superjacent slits always of equal width, and the eye-tube, there is introduced a flint glass prism, and further toward the eyepiece a twin prism; that is, a combination of two flat prisms, touching each other with their thick ends (such, e. g., as are used in Fresnel's interference experiment), and toward the collimator a so-called Rochon's prism. By means of this arrangement there are produced eight spectra, in one plane of which three times two each coincide with each other, and of which each pair are polarized vertically to one another. In the plane in which the spectra appear there is a diaphragm which, at the spot where two spectra polarized vertically to each other coincide, possesses a slit, through which therefore a given color is cut out of both prisms. If we look through the slit toward the twin prism its entire surface is illuminated with spectral light, and we see the upper half of the field of vision illuminated with light of the one spectrum and the lower half with the light of the other. By turning the telescope we can see through the slit another color of both spectra, so that the observation can be effected for each color. If we have only one source of light for both slits, or if we cause two sources of light of equal brightness to act upon one of the slits, there ensues a slight loss in consequence of the reflection within the apparatus, and the two semicircles are not equally illuminated. If we now interpose a Nicol prism between the telescope and the slit in the diaphragm upon which the spectra fall, we can produce an equal brightness of both fields of vis-

ion by turning the Nicol prism. If the sources of light which throw the light into each of the two slits are of different intensity, we can have an equal intensity by another rotation of the Nicol prism. The proportion of the illuminations can be deduced from the angle of deflection.—Annalen der Physik und Chemie and Zeit. fur Analytische Chemie; Chem. News.

[Continued from Supplement, No. 1042, page 16658.]

NOTES ON GOLD MILLING IN CALIFORNIA.*

By Ed. B. Preston.

Screens and Frames.—Screens of different materials and with different orifices are used; the materials comprise wire cloth of brass or steel, tough Russian sheet iron, English tinned plate, and, quite recently, aluminum bronze. The Russian sheet iron plates are perforated with round holes or slots; the latter are vertical, horizontal, diagonal, or curved, and are either entirely smoothed or burred on the inner side. The latter form is intended for longer wear by closing the burrs with a mallet when too large, thereby prolonging the life of the screen. These screens last from fifteen to thirty-five days. The plates have glossy, planished surfaces, and come in sheets of 28 in. to 56 in., costing in San Francisco from 65 to 80 cents per square foot. The English tinned plate screens come in sheets of 1 ft. to 1½ ft. square; they are more flexible than the Russian iron, hence do not permit of the pulp caking along the lower edge when fed high; and, as compared with a Russian iron one of the same perforations, they give a greater discharge, but they are short lived—averaging about ten days. The tin is burned off before using.

Brass screens, costing in San Francisco 36 cents a square foot, are sold in rolls; they give the greatest discharge for an equal area, and last from ten days to two weeks, but should not be used if cyanide of potassium be used in the battery, on account of clogging with amalgam. The "aluminum bronze" plates come in sizes similar to the sheet tinned plate, but unpunched, the latter work being done here; they are much longer lived than either of the other kinds, and have the further advantage that when worn out they can be sold for the value of the metal for remelting; these plates are bought and sold by the pound, and are said to contain 95 per cent. of copper and 5 per cent. of aluminum. Steel wire screens are not much used, on account of their liability to rust. The life of a screen depends, aside from the manner of feeding, on the width of the mortar, the height of the discharge, and the hardness of the rock. Wide mortar and high discharge are favorable to the preservation of a screen. The form of the perforations—round holes, or slots, etc.—influences the discharge area of the screen.

A good deal of confusion exists in interpreting the numbers of the different kinds of screens. Wire screens take their numbers from the meshes to the linear inch, while perforated and slotted screens are numbered from the needle used in punching them, these needle numbers being the same as are used for sewing machines. The sizes most frequently used in gold milling are from No. 6 to No. 9 of the perforated and slotted screens, and from No. 30 to No. 40 of the wire screens. The slots are from ¼ in. to ½ in. long, and placed alternating or even in the rows, some being burred on the inner side.

The following table gives a comparison of the different varieties, with their numbers:

No. of Needle.	Corresponding Mesh.	Width of Slot. (Inches.)	Weight per Square Foot.
5	20	0·029	1·15 lb.
6	25	0·027	1·08 lb.
7	30	0·024	0·947 lb.
8	35	0·022	0·918 lb.
9	40	0·020	0·827 lb.
10	50	0·018	0·735 lb.
11	55	0·016	0·666 lb.
12	60	0·015	0·666 lb.

The proper size required is a matter for the millman to decide at each mill. The character of the ore and the coarseness of the gold have to be considered, as well as the inside dimensions of the mortar; ore carrying extremely fine gold requiring a finer crushing, as the gold must be freed from the quartz matrix in part if the quicksilver is to act on it, but where this would lead to if carried out to its legitimate end may be imagined, when the writer states that he has observed, under the microscope, a particle of quartz that had passed through a No. 9 screen (40 mesh) and still contained several separate but included particles of gold. Sulphide ores, having a much greater tendency to form slimes, should be crushed as coarse as permissible, and where the sulphides predominate largely, amalgamation in the battery is best avoided. The pulp discharged through a screen carries but a small percentage of the size of the orifice; while the largest proportion is much finer, it is possible to use a much coarser screen than the size desired to be obtained without any great detriment, while greatly increasing the output.

The Screen Frame (Figs. 24 and 25).—It is made from strips of sugar pine 1½ in. by 3 in. broad, mortised and reversible; usually they are made to close the entire discharge opening, grooves being cast on the exterior of the mortar for their reception. It is frequently strengthened with one or more vertical ribs across the center opening, and is faced with iron plate on those portions of the side and bottom that come in contact with the iron keys that hold the frame solid against the mortar. In some mills the frame is made several inches lower than the opening, to permit the millmen to observe the interior of the mortar while in action, and to allow the hand to be introduced to remove any chips that may have passed in with the ore, as these have a tendency to bank up against the screen and interfere with the discharge of the pulp. Where such a screen frame is used the opening above is kept covered with a strip of canvas tacked to a wooden rod, laid on the upper projecting lid, while the loose end of the canvas hangs against the inside of the upper part of the screen frame.

The Plate Block (Chock Block) consists of wooden blocks bolted solidly together, and fitted and keyed to the lower edge of the mortar along the discharge opening, with one part projecting above the other, forming a recess on top to contain the screen frame, and lined with a piece of blanket to make a close joint. The inner side is sloped or rounded off, and fitted with an amalgamated plate. The front and ends are faced with iron plate to protect the wood. Two or more sets of these chock blocks should be provided, of which one stands 2 in. higher than the other; they are then used alternately, the higher one with new shoes and dies, to be replaced by the lower one when the dies are worn down somewhat, to retain a more even discharge than would otherwise be possible.

The Drop is the height through which the stamp is raised by the cam, and through which it drops when released. Usually it is the same for all the stamps in a battery, although the end and feed stamps sometimes receive a different drop. It is regulated through the raising or lowering of the tappet, and depends mostly on the hardness of the rock. It is one of the factors in determining the speed with which the blows from the stamp shall be repeated. The usual combination of the two in the California mills is a low drop with rapid motion.

The Discharge is the distance between the top of the die when in place in the mortar and the lower edge of the screen through which the pulp discharges. It is one of the most important factors in the duty of the stamps and the gold output from the ore. It should be maintained as nearly as possible at an even height through the entire period of crushing; the height of the chock block or screen frame being lowered to correspond with the wear of the die. A further means used to retain an even discharge is by placing a 2 in. iron plate under the dies when worn thin. The discharge stands in a certain relationship with the fineness of the screen; low discharge goes with coarser crushing, a high discharge with the opposite. The discharge varies in California from 4 in. to 10 in.

Water Supply.—Water pipes of 3 in. diameter are brought along the front of the mortar near the upper edge, with branch pipes 1 in. in diameter, supplied with faucets leading to the feed side of the mortar, to convey the battery water in at the back, or through the plank covering on the top; this water is under moderate pressure. A second discharge pipe is carried down in front to the lower lip of the mortar, where a movable perforated branch is turned across the front of the screen, discharging along the entire line on the lip; this second discharge pipe also supplies a hose. The battery water should enter both sides of the mortar in an even quantity, and the total amount must be sufficient to keep a fairly thick pulp that discharges freely through the screen. About 120 cubic feet of water per ton of crushed ore may be considered an average, or 8 to 10 cubic feet per stamp per hour.

Aprons and Apron Plates.—The apron is a low table placed in front of the mortar, just below and in immediate proximity to the lower lip of the discharge, for the reception of amalgamated copper plates. It is set on a sufficient grade to permit the discharging pulp to flow over it in an even stream, while affording the suspended amalgam an opportunity to reach, and adhere to, the plate surface. The size, shape and slope are at the will of the millman; but usually they are rectangular, with the plates screwed down to the table with

* From Bulletin No. 6 of the California State Mining Bureau. J. J. Crawford, State Mineralogist.

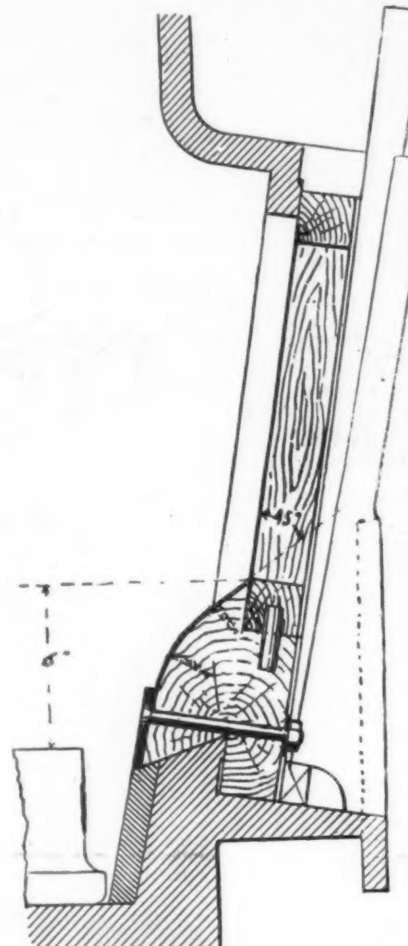


Fig. 25. Adjustable Battery Screen.

As dies wear down, wooden chock-blocks (on which the inside plates are fixed), of less height, are substituted, thereby preserving uniformity in height of discharge.

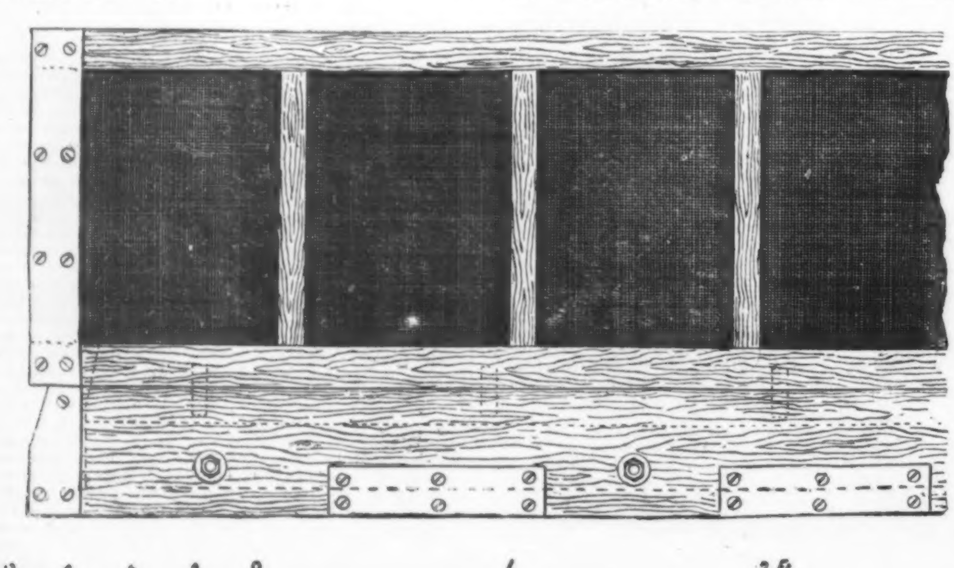


Fig. 24. Battery Screen Frame.

copper screws, perfectly level and smooth, the sides being secured with wooden cleats. The grade given varies from ⅛ in. to 2½ in. to the foot, and the width of the apron is usually the width of the discharge opening of the mortar. In some mills several of these apron plates are placed consecutively, discharging from one to the other. They are usually rigid, but in some instances the apron next to the mortar stands on rollers, permitting it to be rolled back, and thus giving freer access to the front of the mortar. They should not be attached to the battery frame.

Sluices and Sluice Plates.—These vary from 12 in. to 20 in. in width, and are placed below the aprons; they are usually set to a grade different from that of the apron. The plates can be fastened by cleats, or are laid overlapping at the ends, and, if not wider than 16 inches, do not need to be fastened down with side cleats; this permits of their being picked up and cleaned at any time without stopping the battery.

The sluices are rarely over 16 ft. long—more frequently in lengths of 8 ft.—and should always be placed double. The width and grade, as compared with the apron areas, are mostly faulty in California mills.

Clean-up Barrel.—Large mills are supplied with clean-up barrels, which consist of iron barrels sup-

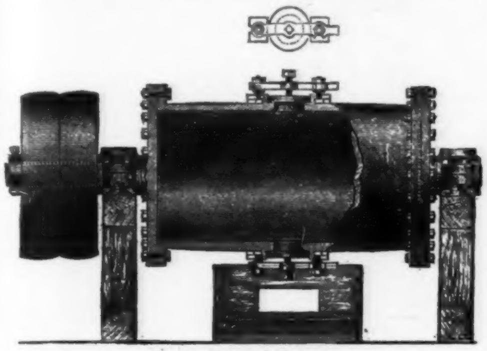


FIG. 26. CLEAN-UP BARREL.

ported by trunnions resting in bearings on short standards. One of the trunnions is extended to carry a loose and a tight pulley, by means of which it is revolved. A manhole, with tight fitting cover, is provided for charging and discharging, and below it is a sluice with cross riffles to receive the pulp when discharged from the barrel. The barrel should make from thirty to forty revolutions a minute, requiring 2½ horse power. It is used to treat the battery sands when cleaning up the mill; also, all the scrapings from the mill floors, as well as sand from the drop boxes and amalgam traps, large pieces of quartz or pieces of broken shoes being added with water and quicksilver to assist in the operation.

Clean-up Pan (Fig. 27).—This is a small amalgamating pan, 3 ft. to 4 ft. in diameter, operating with mullers with wooden shoes, and is run at a speed of thirty

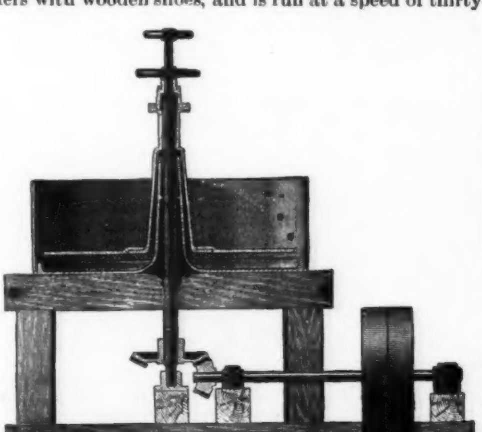


FIG. 27. CLEAN-UP PAN.

revolutions, requiring 1½ horse power. When in use the pan is half filled with water, and the amalgam put in, with an addition of clean quicksilver, and, if required, also some lye. After sufficient grinding, the muddy water is run out through plug holes, the mullers stopped, and the contents drawn off in buckets. The iron found floating on top of the quicksilver is removed with a magnet; the sand is washed off with a small stream of clear water, and if any dross be found covering the surface, it is skimmed off with a sponge or piece of blanket.

Cleaning-up Room.—This is an apartment in close proximity to the batteries and aprons, provided with a tight floor, and with a door under lock and key; the floor is best when laid in cement, to avoid all losses from spilt quicksilver or amalgam. It should be well lighted and furnished with a sloping table large enough to place a screen frame on; also with one or two watertight boxes about 4 ft. long, 3 ft. wide and 3 ft. deep, for panning out purposes; these are supplied with plug holes near the bottom, to drain off the water, besides water pipes and fittings to fill the boxes when required.

One or two wide shelves should be provided to hold the chemicals, quicksilver and utensils needed in cleaning up. The latter consist of pans, Wedgwood mortar, brushes, scoops, cups, knives, chisels, rubbers, scrapers and a supply of closely woven drilling or light canvas; the latter is used to squeeze the superfluous quicksilver from the amalgam. A good pair of balances, with a set of accurate weights, capable of weighing the amalgam and the retorted bullion, should also be provided. The table should be made of a solid plank, or a slab of slate or marble, supplied with a raised edge, and grooved around to drain into a pan placed on a shelf attached below the lower end; some tables are covered with an amalgamated plate.

It is sometimes convenient to have a small safe in the clean-up room, but it is always better to have the amalgam delivered to the office.

POWER FOR MILLS.

On account of the favorable position of the majority of California mines as regards their proximity to mountain streams and the large ditch systems, the application of water for the motive power of the mills is rendered easy, and where the distance from these sources is remote, electricity generated in such localities and transmitted to the mill is being successfully applied. Where steam power has to be used, the well-timbered western slopes of the Sierra Nevada permit the cost of fuel to be kept at a comparatively low figure. Where both water and timber are hard to obtain, as in the desert regions of the southern part of the State, gas engines have been applied with most satisfactory results.

In applying water power, where the pressure is suffi-

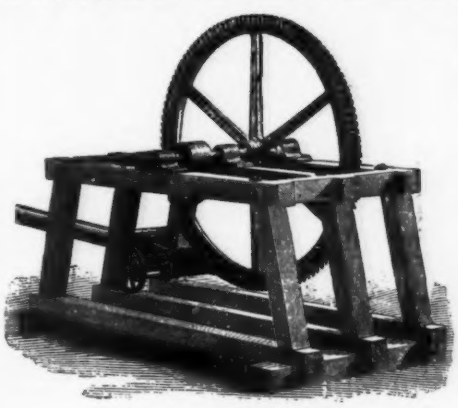


FIG. 28. THE KNIGHT WHEEL.

cient, hurdy-gurdy wheels are chiefly used; these are vertical wheels with narrow breasts, having buckets of various patterns radially attached to the outer circumference, the water being projected through one or more nozzles against the buckets at a low point of the wheel, allowing the water to pass from the buckets as soon as the blow has been delivered. The principal patterns in actual use are the Knight, Pelton and Dodds; the actual effective power developed by the Pelton buckets is given at about 75 per cent. to 80 per cent. Where sufficient pressure cannot be obtained, the Leffel turbine and the overshot wheel are in use. As the Pelton wheel seems to find the most frequent application in California, it may be convenient for millmen to have the following rule applicable to these wheels:

When the head of water is known in feet, multiply

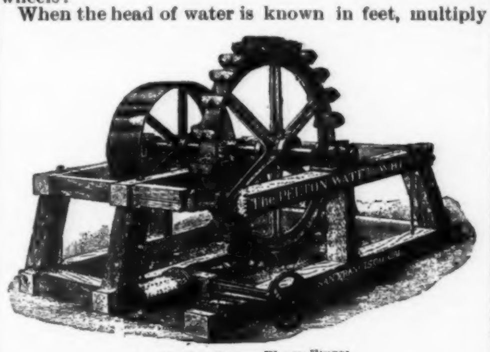


FIG. 29. THE PELTON WATER WHEEL.

it by 0·0024147, and the product is the horse power obtainable from one miner's inch of water.

The power necessary for different mill parts is:

	H.P.
For each 850 lb. stamp, dropping 6 in. 95 times per minute	1·33
For each 750 lb. stamp, dropping 6 in. 95 times per minute	1·18
For each 650 lb. stamp, dropping 6 in. 95 times per minute	1·00
For an 8 in. x 10 in. Blake pattern rock breaker	9·00
For a Frue or Triumph vanner, with 220 revolutions per minute	0·50
For a 4 ft. clean-up pan, making 30 revolutions	1·50
For an amalgamating barrel, making 30 revolutions	2·50
For a mechanical batea, making 30 revolutions	1·00

(To be continued.)

MEISSONIER AND HIS METHODS.

IN his first genre pictures, says a writer in a French paper, Meissonier followed the traditions which were in force in his youth in the French schools of painting. First bits of detail, carefully studied from nature or from the living model, in crayon; then, still in crayon, and after the living model, the whole composition. This composition he reproduced without variation in his picture, the most minute effects of light being indicated in the drawing. It was not long, however, before he became convinced that this system led to monotony of color, and without deflecting from the principle of doing nothing except from nature, which he had made his rule from the beginning, he replaced the crayon study by the painted study. At the same time, in order to leave nothing to chance, he started the practice, whenever he began a picture, of arranging the scenery he was to reproduce in a corner of his studio. This done, he placed the model among the scenery, as if in a tableau-vivant. He never began work until he had carefully studied the place to be occupied by each bibelot, the effect that the hanging would produce, the way in which the light fell on the projections of a cornice, on the mouldings of a piece of furniture or a seat, on the most trifling and humble accessories. If the tapestry which seemed to suit for a background or the armchair in which the principle figure was to sit were wanting in Meissonier's properties, he bought them. If the required object were not to be found, he had it made. He would even order, to copy them better on his canvases, chimneypieces and staircases, which he afterward sold for an old song. When the elements of the picture were collected Meissonier planned out the main lines of it in his mind. Then, without making any preliminary sketch of the whole, he set to work on studies of detail, which were generally studies of costume. He turned out dozens of them, until the costume of each of the figures had taken its form. Work on the head, the details of the face, he reserved until the time when, the picture having been begun, and the actors in the drama being in their places, he had only to give the final touches. But though he worked with great facility and his touches followed each other rapidly and were wonderfully sure, he could not produce quickly. At the most he would finish a leg in a day of steady work. This slowness of execution, however, did not prevent Meissonier's inexorably destroying the work of several days if he were not thoroughly satisfied with it. His desire for perfection rendered him inexorable to everything that did not fully realize his idea. To understand the precautions taken by the painter to obtain absolutely truthful effects in his great works, nothing can be more instructive than the history of "1814," one of the most popular of his pictures. It is thus told by his son: "The execution of the picture, though meditated and composed for months in my father's brain, was long delayed for want of snow. The winter of 1863 was already far advanced and not a flake of snow had fallen. At last it came. When it lay thick enough in our garden my father at once took his measures, had it trampled by the servants and soiled with barrowfuls of earth. It soon became as muddy, dirty, and sad as one could wish. Then and then only my father began to work out of doors, posed his horses, in spite of the low temperature, in the snow, and with prodigious activity pushed on his studies of detail in order to have them complete before the thaw came. Fortunately the hard weather lasted as long as was necessary, sometimes cold, sometimes snowy, but always with the same sad, black sky, laden with opaque clouds—the sky necessary to obtain the desired effect. After the generals of the escort came the turn of Napoleon. All the parts of the costume were ready. They had been made under the supervision of Prince Napoleon and accurately copied from the authentic relics of the Emperor in his possession. The moment had come to clothe the model with them, but it was found that he could not get into them. The coat was too small for him, but, to make up, the hat came down over his eyes. My father tried on the costume himself. The coat fitted him like a glove, the hat adapted itself perfectly to his head. He did not hesitate a moment. He mounted the white horse sent from the imperial stables, took the model's place, and with a mirror set up before him, feverishly copied his silhouette and the background against which it stood. The cold was intense, and my father's feet almost froze in the stirrups. Chaufferettes were held under them and a brazier was placed beside him for him to warm his stiffened fingers. Friends tried to convince him that he was giving himself unnecessary trouble. When the landscape was done why should he not go back to his warm studio to paint the figures? My father rightly observed that in the studio the values, the relations of the tones of the figures to the landscape, would be wanting, and he held out to the end. All the studies were made under the same conditions."

CALVERT VAUX.

IN the death of Calvert Vaux, who was accidentally drowned near this city, November 20, the profession of landscape art in this country has suffered an almost irreparable loss. Born in London almost seventy-one years ago, he had already achieved distinction in his profession as an architect when at the age of twenty-four he accepted an invitation from Andrew J. Downing to come to this country as his business associate. He had a talent for landscape painting and an appreciative love of scenery, which enabled him to combine effectually natural objects and artificial structures. For several years the two artists were successful colaborers in the field of landscape art, and at the time of Downing's untimely death in 1854 they were engaged in designing and constructing the grounds about the Capitol and Smithsonian Institution, in Washington, the most important work of the kind which had yet been attempted in this country. Meanwhile, the gathering sentiment in favor of spacious and accessible city parks which had found expression in the eloquent letters of Downing at last secured, through legislative action, the purchase for a public pleasure ground of the rectangular piece of land now known as Central Park. In 1858 the city authorities selected, out of thirty-three designs offered in competition for the new park, the one signed "Greensward," which was the joint work of Frederick Law Olmsted and Calvert Vaux, and Central Park as we know it to-day is the realization of this design in its essential features. This was the earliest example in this country of a public park conceived and treated as a consistent work of landscape art, and the first attempt in any country to plan a spacious pleasure ground which should have the charm of simple, natural scenery while it met the requirements of complete inclosure by a compactly built city. No one can read the original plan as presented for competition without feeling how thoroughly an experience of nearly forty years has justified the forethought of the young artists, or without a sense of gratitude to them that our first great park, which has to such an extent furnished a stimulus and a standard to other American cities for similar undertakings for all time to come, was a work of such simplicity, dignity, refinement and strength. It may be added that this "Greensward" plan, together with other reports on Central Park, on Morningside and Riverside Parks, of this city, on parks in Brooklyn, Albany, Chicago, San Francisco and other cities, both in this country and the Dominion of Canada, by the same authors, con-

tain a consistent body of doctrine relating to public pleasure grounds, a systematic theory of park art, with illustrative examples, which is unique and invaluable. Mr. Vaux had been a member of many important commissions and he acted as landscape adviser for the Niagara Falls Reservation, but for more than thirty years his best work and thought had been steadily given to this city, where, as landscape architect of the Department of Parks, he had designed many minor parks and squares as they have been acquired, and had completed the details of the larger ones. He had the genuine creative faculty which gave the stamp of originality to all his wo k, and a severity of taste which preserved it from anything like eccentricity or extravagance; and while thus fully equipped on the artistic side, he had a fertility of resource and an unflagging industry which enabled him to grapple successfully with all the complicated practical problems of his profession.

In private life Mr. Vaux was a man of singular modesty, gentleness and sincerity, and while his learning and accomplishments gave him an assured position in the republic of letters and of art, his kindly and unselfish disposition endeared him to every one with whom he was closely associated. As a city official he was a model of intelligent zeal and sturdy integrity, and no man in public life was ever more loyal to his duty or to his art. More than once, when some construction affecting the design of the parks was undertaken against his advice, he promptly resigned, but in every instance he was quickly reinstated in obedience to a vigorous demand of the people of the city, who felt assured that while his counsel prevailed their pleasure grounds were safe. To Calvert Vaux, more than to any other one man, this city owes a debt of gratitude for the fact that Central Park, in spite of attacks on every side, has been held so secure against harmful invasion and has been developed so strictly on the lines of its original artistic conception.

[Continued from SUPPLEMENT, No. 1042, page 16661.]

COMMERCIAL FIBERS.*

By D. MORRIS, C.M.G., M.A., D.Sc., F.L.S., Assistant Director of the Royal Gardens, Kew.

LECTURE II.

ENDOGENOUS FIBERS.

THE fibers of endogens or monocotyledonous plants are found isolated in the stems and leaves. They do not form a continuous ring as in the bast fibers of dicotyledonous plants. They occur in definite bundles, called fibro-vascular bundles, distributed in the cellular tissue; and usually inclosed in a bundle sheath. All the fibers proposed to be dealt with in this lecture are derived from the leaves of tropical endogenous plants. In fact, they may very appropriately be called leaf fibers, as opposed to the stem or bast fibers of exogenous plants treated in the last lecture. The mode of occurrence of the leaf fibers is very similar in all cases. A typical example is found in the valuable fiber obtained from the leaves of species of Agave. This fiber is known in commerce as Sisal hemp. The leaves in this case are sword shaped, somewhat fleshy, firm in texture, and terminating in a sharp spine. They are arranged in a rosette, with about thirty or forty leaves in each rosette. The most familiar example of this is the common American aloe.

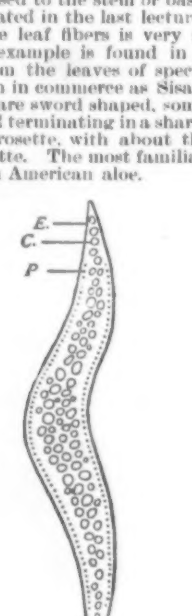


FIG. 7.—SISAL HEMP (AGAVE RIGIDA, VAR. SISALANA).

Transverse section through the middle of the leaf. The right hand side represents the upper surface; E, epidermis; P, peripheral row of bundles; C, central row of bundles.†

The above figure gives the appearance of an Agave leaf, cut transversely to its axis. The fibro-vascular bundles are of two kinds: First, there are the peripheral rows of small bundles, occurring immediately under the epidermis, on both surfaces of the leaf. These two rows extend from the center outward, but they terminate abruptly before they reach the margin. Secondly, there are the central bundles of fiber, one row of which reaches quite to the margin of the leaf. These central bundles vary considerably in size, those near the center being generally largest. At the center the rows are two to four deep. The space between the bundles is occupied by small celled tissue, called the parenchyma. This is merely a packing material, and is useless for fiber purposes. To find the fiber material, and its structure relatively to other tissues, we must examine one of the fibro-vascular bundles from the center of the leaf.

The whole bundle is surrounded by the small celled parenchyma, only slightly shown in the above figure. Next comes the large, thin walled cells of the starch layer, completely surrounding the bundle. Inside this is the large mass of tissue called the sclerenchyma,* somewhat crescent shaped, and embracing within its two horns the vascular bundle. The crescent shaped mass is made up of a number of thick walled cells with a central cavity. These cells form the fiber of commerce. The vascular bundle consists of two parts, the wood and the bast. In endogens the bast is useless for fiber purposes, hence it is incorrect to speak of the bast fibers of monocotyledonous plants. To extract the fiber cells in this case it is necessary in the first instance to get rid of the small celled parenchyma, and also of the vascular bundle. The fiber bundle would then consist (in section) of a crescent shaped body made up of thick walled cells only. These cells may number from fifty to two hundred in

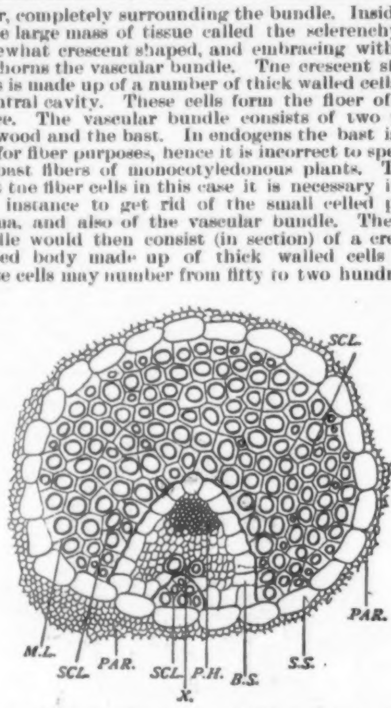


FIG. 8.—SISAL HEMP (AGAVE RIGIDA, VAR. SISALANA).

Transverse section through a fibro-vascular bundle embedded in (PAR.) the cellular parenchyma. S.S., starch layer, forming a ring round the sclerenchyma (SCL.), with the fiber cells closely packed together. M.L., middle lamella. B.S., bundle sheath. X., xylem, or wood cells. P.H., phloem, or bast cells. × 300.

each bundle. They are closely compacted by pressure, and their walls have grown so thick that the internal cavity, in some cases, is almost blocked up. Each cell is really separated from its neighbor by a thin partition called the middle lamella.

The further structure of a fibro-vascular bundle is shown in a longitudinal section. On each side, as before, is the parenchyma, next the starch layer, and then the fiber cells or sclerenchyma. In the longitudinal section above SCL. is seen the somewhat abrupt termination of one or two of those fiber cells (known as the transverse septum). Next to the sclerenchyma is the bundle sheath, B.S., and then come the wood cells, X. These are long, wide, somewhat thick walled, and characterized by peculiar ladder like markings. Next to the wood cells comes the bast or phloem. The cells are mostly short, very delicate, and thin walled. It is evident that they are useless for fiber purposes. The fiber cells, it is noticed, are very long; they have a narrow internal cavity, and

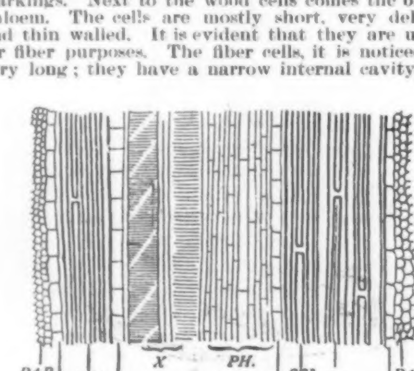


FIG. 9.—SISAL HEMP (AGAVE RIGIDA, VAR. SISALANA).

Longitudinal section of a fibro-vascular bundle: PAR., parenchyma; S.S., starch layer; SCL., sclerenchyma; B.S., bundle sheath; X., xylem; PH., phloem; T.S., transverse septum (termination of fiber cells). × 300.

lastly, they have thick cell walls. All these points add to their value as a fiber material. They are the essential parts sought for in fiber plants, and, as will be shown later, they constitute in all cases the fibers of commerce.

MANILA HEMP.

The plant yielding Manila hemp (Musa textilis) is a wild plantain, native of the Philippine Islands, where several varieties are now cultivated for the sake of the fiber. The stem, made up of the leaf sheaths, rises to the height of twelve to twenty feet, with leaves similar to the common plantain, but narrower. The fruit is hard and dry, not edible.

Cultivation.—The plant is propagated by means of suckers thrown out at the base of the parent stem. Plantations are established in fresh clearings on low hills and under the shade of trees, left standing at sixty feet apart. The cost of establishing plantations is about £5 to £8 per acre, not including the cost of the land. After this the yearly expense of weeding and maintaining the plantation in full bearing is at the rate of 30s. to 35s. per acre. The first crop is reaped at the end of eighteen months or two years after planting. The yield during the third and fourth years is at the rate of four hundred pounds to seven hundred pounds of dry fiber per acre. The cleaning is done entirely by hand. No machine has yet been invented that will extract the fiber so efficiently and cheaply. A laborer, working under pressure, will clean about twenty pounds of hemp per day. Usually two men work together, one cutting down the soft stems and splitting them, while the other cleans the fiber. In many cases the workers are paid one-half of the price of the fiber cleaned per day. At the current value of hemp in 1879, one laborer's earnings were estimated at 7½d. to 8d. per day. From these particulars it may be gathered that the Manila hemp industry in the Philippines is fostered by very exceptional circumstances. The plant is native of the country. It is cultivated on virgin soil, of which, in that part of the world, there is an unlimited extent; and, in addition, the labor supply is both cheap and abundant. It is important to bear these facts in mind in starting the cultivation of any fiber that is likely to come into competition with Manila hemp. Even in the Philippines there are districts in the western and northern parts, with a drier climate, where the plants will not grow. Hence it is useless to attempt to establish a Manila hemp industry in any country where the soil is not rich, and where there is not an abundant rainfall well distributed throughout the year.

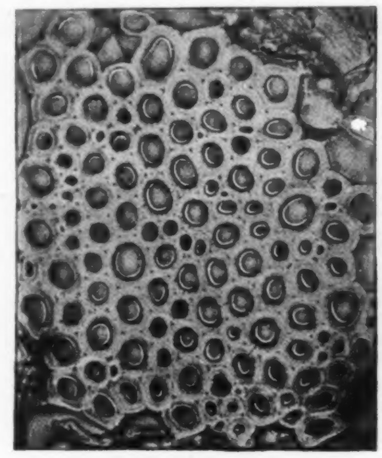


FIG. 10.—MANILA HEMP (MUSA TEXTILIS).

Transverse section through a fibro-vascular bundle from the leaf sheath forming the so-called stem of the Manila hemp plant. The fiber cells are variable in diameter, with the cavity circular or oval. The divisions between the individual cells are more clearly shown in Fig. 8. × 300.

Fiber in Commerce.—Manila hemp is "the chiefest and best" of white cordage fibers. After it is extracted by hand it is thoroughly dried in the sun and packed by hydraulic pressure in bales ready for shipment. Hemp not properly dried, or exposed to rain, becomes discolored and loses strength. It is characteristic of Manila hemp that it readily absorbs moisture and in an ordinary dry condition it contains 12 per cent. of "water of condition." The various qualities of Manila hemp in March, 1895, were selling per ton as follows: Lupiz, £30 to £50; Quilot, £28 to £40; prime roping, £21 to £25; fair current, £17 to £18 10s.; seconds, £16; good brown, £14 10s.; common do., £13 10s. At this time Sisal hemp was selling per ton at £14; Mauritius hemp at £21 to £24; New Zealand Phormium at £12 to £14. The prices above quoted afford a very fair criterion of the relative value of these fibers. The position of Manila hemp practically determines the prices paid for all white rope fibers. About 50,000 tons of fiber are annually exported from the Philippine Islands, and the estimated value is not less than about £2,500,000 sterling. Although the bulk of the shipments of Manila hemp is received in this country, a large part is reshipped to the United States. For instance, in 1891 there were received 448,000 bales of Manila hemp. Of these 175,919 were reshipped to America. The total receipts in the United States during 1891 (direct and indirect) were 316,677 bales. If we include Manila and Sisal hemp, the consumption of these fibers in the United States is more than twice as much as in the United Kingdom.

Economic Uses.—Manila hemp is largely used as a material for white ropes for rigging and other purposes. It is also largely used for binders for reaping machines. Old Manila ropes make an excellent paper material. The manufactured articles made of Manila hemp in the Kew Museum consist of mats, cords, hats, plaited work, and lace handkerchiefs. One of the latest applications of this fiber is in the manufacture of lace and materials for ladies' hats and bonnets.

A successful attempt to establish a Manila hemp industry in British North Borneo has lately been reported. Owing to the heavy taxes in the Philippines, it is claimed that North Borneo can export its fiber at a lower cost than the Philippines.

PLANTAIN AND BANANA FIBERS.

Besides Manila hemp, produced by Musa textilis, other species produce fiber useful for cordage purposes, for mats and for making coarse paper. The plantain, in Jamaica (Musa sapientum, var. paradisiaca), produces a white, glossy fiber at the rate of 1·81 per cent. of the gross weight. The price of the best plantain and banana fibers is, however, seldom above £12 per ton, and they would only fetch this price when there is a high demand for white rope fibers and a short supply of Manila and Sisal hemps. In spite of this, it is worthy of consideration whether the immense number of banana stems cut down every year in the West Indies (estimated at 50,000,000) could not be utilized for their fiber. It is evidently not sufficiently good to compete with first class rope fiber, but it might possibly be used for making coarse paper, as a packing material, or even for the manufacture of papier maché. The Abyssinian banana, Musa Ensete, yields a somewhat weak and dull-looking fiber. Musa Bajoo is grown in Southern Japan for its fiber, which is woven into cloth of an exceedingly durable character. Musa sumatrana, forming an impenetrable jungle in the Malay Peninsula, may eventually prove a useful fiber plant. A banana, native of the Solomon Islands, yields fiber which is woven into ornamental garments, bags, and sleeping mats.

* Lectures before the Society of Arts, London, March, 1895.—From the Journal of the Society.

† Figs. 7, 8 and 9 are adapted from a paper by Mr. C. H. Nicholls, B.A., in the Journal of the Institute of Jamaica, vol. I, p. 154.

* From the Greek skleros, stiff, hard.

PINEAPPLE FIBER.

The common pineapple (Annanas sativa) has a rosette of thirty to fifty narrow, strap-shaped leaves, from 3 to 5 feet long. These contain an abundance of fiber which, though somewhat difficult to extract, is possessed of great merit. It is finer and stronger than that yielded by almost any other plant except China grass. In the East Indies it is manufactured into a beautiful fabric known as "piña" cloth. In the Straits Settlements, Sierra Leone, and some other localities in the old world, this tropical American plant has become thoroughly naturalized. The leaves in these semi-wild plants are more highly developed than in plants cultivated for the fruit, and hence are better suited for fiber purposes. In the Philippines it is also customary to pluck the fruit before it matures; this is said to cause a considerable extra development of the leaves.

Pineapple plants are grown in every tropical country, and their cultural treatment is well known. They are easily propagated by means of offsets from the base. The leaves are fully developed in about twelve to eighteen months, and each plant could yield at least ten to twenty leaves every year. For piña cloth the fiber is extracted by scraping by hand, then washed and laid out to bleach in the sun. The steeping, washing, and drying are repeated until the fibers are considered to be properly bleached. The fiber bundles are very fine, transparent, strong, and supple. The ultimate cells are from 2 to 5 mm. long, fine, uniform in diameter throughout, solid and glossy.

A sample of pineapple fiber of excellent and extraordinary length (6 feet), grown at Malacca, was brought to this country by Mr. Derry in 1893. It was stated, in the Kew Bulletin, 1893, p. 368, that one manufacturer was hopeful of using 1,000 tons a year or more of this fiber at the price of £30 per ton, delivered in London. "Pineapple hemp" is a regular article of export from Formosa to Swatow, where it is made into fine "grass cloth," esteemed for its coolness as a summer wear.

CARAGUATA FIBER.

Caraguatá (Bromelia argentina).—The best fiber of Paraguay is "Caraguatá ibera." It is described as long and silky. There is frequent mention of it in works of travel, and fine specimens were shown in the Paraguay Court at the Exposition Universelle, held at Paris in 1889. Specimens of the plant, abundant in a wild state, were received at Kew in 1890, and it was found to be a new species of Bromeliaceæ allied to the pineapple, which it resembles both in habit and character of the leaves. In a report furnished to the Foreign Office by Mr. Arthur Herbert (No. 1,006, 1892), it is stated "the ibera is a sort of caraguatá, and its fiber is of a finer quality than that of its congener, but neither of them has obtained any importance in commerce, owing to the cost of cleaning and separating the fiber from the leaves. Several attempts have been made, but so far without any great success. From the interest that has been awakened in this product in European markets, it would seem to deserve a more serious study, and the opinion seems to prevail that with improved machinery and more skillful administration more profitable results might be obtained." Any machinery that could successfully extract pineapple fiber could also clean the caraguatá fiber. It is anticipated by those acquainted with the local circumstances that caraguatá fiber will some day form an important article of export from Paraguay.

OTHER BROMELIA FIBERS.

According to the Kew Bulletin, 1887, April, p. 8: "There are several samples of a wild pineapple (Bromelia sylvestris, Willd.) from the West Indies and Central America at Kew, but there is no record of their commercial value. A sample supposed to be from this plant was lately sent from Trinidad, upon which the brokers reported as follows: 'Not yet in commercial use, but destined, we think, to a successful future; fine, soft, supple fiber, strong and good color, ample length; say £30 per ton and upward.'

"The fiber of the Jamaica pinguin (Bromelia Pinguin, L.) would appear not to be of high value. The plant covers hundreds of acres in the plains and lowlands of Jamaica, and an effort was made some time ago to prepare the fiber for commercial purposes. The report of brokers upon a sample of 90 lb. was as follows: 'A long, towzeled, weak fiber, of bad color, coarse, no strength, and only fit for breaking up. Similar to St. Helena hemp tow, but not so good. We should think £12 to £10 per ton the utmost value.' Several samples of this Pinguin fiber from Jamaica and elsewhere, cleaned both by hand and by machine, are to be seen in the Kew Museum, No. II."

Another bromeliad (Karatas Plumieri) with leaves 8 to 10 feet long, armed with distant, incurved teeth, is common in tropical America. It is a well-known and valuable fiber plant. It is said to be used by Indians in making the finest hammocks in Central America, Guiana, and Brazil.

BOWSTRING HEMPS.

The species of Sansevieria yielding bowstring hemps have creeping rhizomes and a rosette of leaves of a fleshy character, sometimes flat, concave, round or spear-shaped. The flowers are in spikes or clusters, white or green. The leaves are dark green, more or less succulent, and banded or mottled with white or black markings. They abound in a very valuable fiber, remarkable alike for fineness, elasticity and strength. The Sansevierias are chiefly of African origin, but one at least may be Indian. Some of the species are already widely distributed in tropical countries. They are capable of being propagated very readily. Usually the rhizomes are divided and planted; plants may, however, be raised from seed, or, better still, from the leaves, which, if cut into pieces about two or three inches long, readily take root in moist situations. Plants may be put out at 3 or 4 feet apart. The first leaves for cutting may be produced in three to four years. In India, with Sansevieria roxburghiana, 1 lb. of fiber was extracted from 40 lb. of small green leaves. It was calculated that "one acre would yield 1,613 lb. of clean fiber at a gathering, two of which may be reckoned on yearly." So far Sansevieria fiber is not in commerce. It is, however, used largely in India—where it first received the name of bowstring hemp—in Ceylon, and on the west coast of Africa for twine and cordage, and is regarded as most valuable. The fiber of Sansvieria cylindrica, known in Angola as "Ifé," is said to be the best fitted for deep sea sounding of any fiber known. The special merits of the fiber yielded by each species will be mentioned below.

Konje Hemp (Sansevieria guineensis).—One of the oldest and best known species. The mottled leaves are somewhat flat and leathery, about 3 to 4 feet long, 3 inches broad in the middle. On the Zambesi it yields "a valuable fiber similar to Manila hemp." It grows "in great abundance in many places, keeping to the shade of woods." In Mauritius, Jamaica, Cuba and Trinidad it is semi-wild and yields excellent fiber. In Jamaica the return, under favorable conditions, is estimated at 1½ tons of dry fiber per acre, of the gross value of £45. Samples received in this country from Trinidad, in 1886, were valued at £20 per ton, but the color and strength were not normal. Good machine-cleaned fiber from Cuba is said to have realized £50 per ton.

Sansevieria Longiflora.—This plant is a native of equatorial Africa. The leaves are like those of S. guineensis, but usually larger or flatter and not invariably blotched with green. The best distinction is the individual flower, which is 3¾ to 4 inches long, while in S. guineensis it is only 2 inches long. Fiber from S. longiflora, grown at Kew, was described in 1887 as "very bright, clean and strong; in every way a most desirable commercial article. It would compete with the best Sisal hemp for ropemaking purposes. Value, £30 per ton."

Pangane Hemp (Sansevieria Kirkii).—The leaf is very horny in texture, with a brown edge, much mottled on both sides. This species was discovered by Sir John Kirk, who states: "It grows abundantly near Pangane on the mainland opposite the island of Zanzibar. . . . It is used by the natives and yields a long and useful fiber." The robust habit and large size of the leaf of this plant render it very valuable for fiber purposes. Under exceptional circumstances a single leaf will attain the height of 9 feet. Fiber from a plant grown at Kew was valued in 1887 at £27 per ton.

Neyanda (Sansevieria zeylanica).—This has long been cultivated in Ceylon. The leaves are semicircular in transverse section, 1 to 2 feet long, dull green with a red margin, and copiously banded with white. The Singhalese use the fiber in numerous ways for string, ropes, mats and a coarse kind of cloth.

Generally the fiber is prepared by retting or by simple beating and washing. The small size of the leaves, and the difficulty of handling them in large quantities, would render this species of less value commercially than any of the preceding.

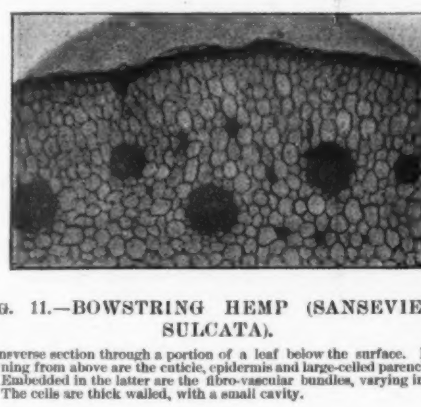


FIG. 11.—BOWSTRING HEMP (SANSEVIERIA SULCATA).

Transverse section through a portion of a leaf below the surface. Beginning from above are the cuticle, epidermis and large-celled parenchyma. Embedded in the latter are the fibro-vascular bundles, varying in size. The cells are thick walled, with a small cavity.

Ifé Hemp (Sansevieria cylindrica).—This is a most distinct and curious-looking plant. The leaves are quite cylindrical and solid, about 3 to 4 feet long and about an inch in diameter at the base. When growing they look like a cluster of sharp-pointed stems. The species extends across South Africa from Zanzibar to Angola. The fiber, as already stated, is very valuable. Specimens prepared from plants grown at Kew were valued at £28 per ton. S. sulcata is very similar, but the leaves are more slender, with rather deeper vertical grooves. The fiber is slightly weaker and valued at £26 per ton.

Moorva or Indian Bowstring Hemp (Sansevieria roxburghiana).—This plant was long confused with S. zeylanica, but Sir Joseph Hooker ("Flora of British India," vi, p. 271) has shown it to be quite distinct. The leaves reach 4 feet in height, narrow and semicircular in transverse section, faintly clouded with black. The plant is cultivated for the sake of its fiber and is the original bowstring hemp plant. The many uses to which the fiber is applied in India are fully described in Watt's "Dictionary of the Economic Products of India," vi, pt. 2, p. 460.

As regards the foregoing species, it may be mentioned that the fiber of Sansevierias, in competition with Manila and Sisal hemps, has possibly very little future before it. It is, however, so soft and silky and possesses so much elasticity and strength that it is well fitted for numerous other uses. The fiber cells have a length of 1·5 to 3 mm. When more widely known and dealt with on an extensive scale, the Bowstring hemps are likely to prove most valuable. They flourish in rather damp situations, under the shade of trees, and extensive areas in west Africa and other countries could be devoted to the cultivation of these plants. When once established, they remain as a permanent crop, yielding regular cuttings of leaves two or three times a year.

Somali-land Fiber (Sansevieria Ehrenbergii).—This was first brought into notice in 1892, under the name of "aloe" fiber. The plant was determined at Kew as a species of Sansevieria, first collected by Dr. Schweinfurth between Athara and the Red Sea, and named by him S. Ehrenbergii. It is growing in large quantities in Somali-land, on the African coast, opposite Aden. The leaves are solid and almost circular, very stout and rigid, glaucous, and terminate in a strong, rather sharp point. Some are over 7 feet in height.

The fiber received in this country was described by Messrs. Ide and Christie as "an excellent fiber of fair length and with plenty of life, . . . with the exception of its color; its preparation is perfect, and even as it is we value it to-day (June 27, 1892) at £25 per ton."

This plant differs from other species of Sansevieria, as it is evidently adapted to very arid conditions. It might, therefore, be found valuable for cultivation on land too dry for other produce. Lieutenant Colonel Stace mentions that there is any "amount of 'aloe' within reasonable distance [of the Somali coast], and it would be much improved by being properly cultivated." In preparing the fiber "the plant is not cut, but pulled out of the ground and the sharp points cut off. It is then divided into two down the middle and beaten with a stick until quite soft. The pieces are then drawn between two strips of wood fastened tightly together until all the pulp is squeezed out; no water is used. When quite dry, the fiber is ready for shipment." It is specially mentioned that the fiber must be extracted directly the plant is gathered, or it is spoiled.

SISAL HEMP.

Sisal hemp, Henequen, or Yucatan hemp, is produced by a species of Agave, native of Mexico, of which the common "American aloe" is the type. There are two, if not more, varieties cultivated for fiber. The chief one is the "Sacqui" (Agave rigida, var. longifolia). Plants were received at Kew in 1879, and again in 1890. The other is the "Yaxqui" (Agave rigida, var. sisalana). The former has leaves with side teeth and a strong terminal spine; the latter has the terminal spine only; the edges of the leaves are smooth.

Cultivation.—These Agave plants are propagated either by suckers from the base of the stem, by seed, or by bulbils (called "pole" plants) produced on the flowering branches. The latter appear in the axils below the flower and number many thousands. They remain in the parent plant until they are about four to six inches long, and sometimes much longer.

The land suited for the cultivation of Sisal hemp is entirely different from that required for Manila hemp. The best fiber districts in Yucatan possess an arid climate, with gravelly, stony or rocky soils; they are only a few feet above the level of the sea; the summer heat is intense. It is claimed that the fiber is stronger and more abundant in dry, hot soils than in rich, deep soils. The plantations are formed with young plants about 18 to 20 inches high. These are put out in rows, at distances varying from 6 to 12 feet apart, equal to about 600 to 1,000 to the acre. Broad lanes are left here and there for the purpose of making roads or tramways, all converging on the factory, where the leaves are cleaned. A plantation begins to yield in three to five years, depending on the size of the plants when first put in and the nature of the soil and cultivation.

Harvesting.—When the leaves are fit to cut 10 to 20 are taken from each plant, beginning from below. The cutting may be repeated two or three times a year, according to the vigor of the plants. As soon as a plant shows signs of "poling" it is regarded as useless for fiber purposes. The pole is cut out and the remaining leaves are harvested soon after. To provide for the continuance of the plantation "it is the custom to place at the foot of each plant (when about three-fourths of its life are spent) a small plant which replaces the old plant when the latter is removed." The period of the life of a plant may extend from five to ten years or more. Cutting the leaves too severely will accelerate the poling of the plant, and thus destroy its usefulness.

Extracting the Fiber.—The leaf cutters are paid at the rate of 25 cents per day for 200 leaves. The leaves are conveyed from the fields to the factory either on mule back or by means of light tramways. Each mule carries 200 leaves each trip; a task of 10,000 leaves requires ten trips, with five mules each. On the tramway a mule can draw a wagon with 3,000 leaves and make five trips a day. Most of the large fiber estates in Yucatan are provided with light portable railways on the French Decauville system. The more common machine used for extracting the fiber is the "raspador." It is a rude piece of machinery consisting simply of a wheel like a four foot pulley with a six inch face. Across the latter are fitted pieces of brass an inch square and six inches long, running across the face about a foot apart. This wheel runs in a heavy wooden frame and makes about 110 revolutions per minute. The leaf is put in at one end of the machine and held by a strong clamp while exposed to the beaters. The pulp is soon crushed out of it, leaving only the fiber. The leaf is then reversed and the other end cleaned in the same way. The average work of one machine, requiring 1½ horse power, is 7,000 to 9,000 leaves per day with two men feeding. It is estimated that 1,000 ordinary leaves will yield 50 pounds of dry fiber. Exceptionally they will yield 100 pounds, but from strong plants from five to seven years old 75 pounds would be a good yield. After the fiber is cleaned it is spread out in the sun to dry. It is afterward pressed into bales by lever or screw presses or by hydraulic pressure. The latter method is becoming general. The bales vary from 350 to 400 pounds, with a cubic measurement of 22 feet. It is calculated that the total cost of growing and cleaning the fiber and of delivering it at Progresso, the port of shipment, is about 3½ cents to 4 cents per pound Mexican money (about 1½d. to 1¾d. English money).

Position of the Industry.—The fiber plantations in Yucatan are estimated to cover about 224,000 acres. The total yield in 1892 was 350,000 bales of 375 lb. each, giving a total weight of 131,250,000 lb. For the whole country, this would be at the rate of 760 lb. per acre. The actual return is probably a good deal more, as the total area under cultivation is not all yielding fiber. The estimated yield of the Yucatan plantations in 1895 was 400,000 bales. A state duty of 20 cents per 100 lb. is levied on hemp exported from Progresso. A detailed account of the fiber industry in Yucatan is given in the Kew Bulletin, 1892, pp. 272-277, and 1893, pp. 212-218. The latter was prepared by her Majesty's vice-consul at Progresso. A general account of Sisal hemp plants and efforts to start industries in various countries is given in the Kew Bulletin, 1892, pp. 21-40. Attached to this is a return of the average price per ton (spot value) obtained for Sisal hemp in this country for each month from January, 1879, to December, 1891.

The following is a brief summary, based on this return, brought down to September, 1895:

Year.	Highest.		Lowest.		Average for the year.	
	£	s.	£	s.	£	s.
1879	32	10	21	0	24	0
1883	29	0	24	0	27	0
1889	56	10	45	0	50	0
1894	20	0	15	0	17	10
1895 Jan. 1 to Sept.	17	0	13	0	14	7

The fall in prices, so marked in the United Kingdom since 1889, was equally prevalent in the United States. This will appear from the following:

PRICE PER POUND IN NEW YORK, DEC. 31.

1892.	1893.	1894.	1895 to Sept.
Cents. 6 to 6¼	Cents. 3⅞ to 3¹⁵⁄₁₆	Cents. 2⅝ to 2⅞	Cents. 2⅛ to 4⅝

Note added.—The monthly report on Sisal on the 15th September, 1895, showed a more favorable tendency. The spot value was £16 to £17 per ton.

(To be continued.)

NEW YORK CUT FLOWER COMPANY.

AFTER entering the wide hall of the spacious building at 119 West Twenty-third Street, New York, the visitor is carried by the elevator to the second floor and ushered into the commodious rooms of the New York Cut Flower Company. The first glimpse of the main salesroom, even at a quiet hour of the day, suggests a large and multiform business; in a busy time the visitor finds himself among the largest collection of cut flowers on this continent. A moment is needed to collect himself after the burst of color and gale of fragrance which greet him, and then he will see substantial broad white tables ranged along the sides of the room and set in parallel rows between them, with generous floor spaces reserved for salesmen and buyers. Every day of the week this room presents an animated scene, for, even on Sunday, in the early morning, exceptionally energetic Christian buyers are on hand for the freshest and most fashionable flowers for decorating houses of worship. On the continuous broad tabling along the walls stand large boxes of roses as they come packed by the growers. The contents of others are deftly arranged in great heaps on the tables in front, which serve as counters. Other parts of the salesroom are used for carnations, violets, lilies, mignonette, smilax, lily of the valley, with its poetical name here, as elsewhere, in the flower trade, cruelly abbreviated to "valley," with other flowers in season.

Passing into a middle room, which at this season is reserved exclusively for chrysanthemums, a new effect is witnessed. On side tables masses of immense flowers are grouped in deep mahogany-colored vases made of "Fibrotta," a preparation of wood pulp with a hardened shell and glazed surface. These tumbler shaped vessels are eighteen inches deep and nine inches across at the top, but their ample size is needed for the tall, stout stems and the weighty flower heads they support.

In the middle of the room the floor is closely covered with open boxes, each containing twenty-five chrysanthemums—the long stems and their dark luxuriant foliage nearly filling the boxes, which are four feet or more long, half the blooms being at each end of the box, and especially choice and tender flowers separately wrapped in tissue paper. Recently, in a collection whose quality suggested an exhibition for effect and for premiums, choice specimens of the new white Mayflower were, perhaps, the most sensational flowers. This variety and Nemesis, resembling the Daybreak carnation in its delicate pink color, commanded the highest prices of all. Flowers of Major Bonnaffon were also conspicuous among the best stock, and so were those of Philadelphia, the favorite new seedling of 1894.

The third room of this immense floor, which, in its length of two hundred feet, reaches entirely through to the Twenty-fourth Street front, is in a way even more interesting than the others. This apartment, which is not open to the public, is the receiving depot. A powerful elevator lifts the boxes after they are deposited on the first floor at this end of the building, where they are brought by immense vans direct from the growers' establishments or by express wagons from railroad stations. The boxes measure about five feet in length and six inches in depth. Many are made of wood, the corners protected by zinc strips, and other metallic looking ones, two feet deep, are of heavy glazed papier maché, iron bound and securely strapped. The boxes are at once opened, the flowers examined and graded according to established standards, and a credit slip made out in the shipper's name, with memoranda of the kind of flowers, the number received, and whether of the first, second or third grade. The flowers are then passed into the salesroom or stored in great refrigerators, which are ranged along one side of the receiving room in unbroken lines and have altogether a capacity of nearly five thousand cubic feet.

The New York Cut Flower Company, of which this is the home and business center, is an organization new to this industry. It is not a trust, and does not attempt to regulate business of its members, but it is a combination of some fifty commercial cultivators, who joined together to sell their products to wholesale buyers direct, instead of shipping, as heretofore, to commission houses. It has been estimated that the flowers sold on commission in this city in a year have a total value of one million dollars. If this is double the real sum, the fifteen per cent. charged by commission merchants would even then amount to $75,000, and the combined growers thought they could get their flowers to the retailers for less money. At all events, they can now know definitely about the sales of their stock, and if reports come back to the effect that it is unsalable, for some reason, they can investigate the matter as they could not do when the flowers had been sold on the old plan. The company includes members from this State, New Jersey, Pennsylvania, Connecticut, and Rhode Island. More than ninety per cent. of the members use above twenty thousand square feet of glass, and some have glass houses which cover a hundred thousand feet. Many members are stockholders, and those who are not sign certain co-operative contracts, in which they agree to sell all their flowers through the company.

Growers who aim to get the best flowers to market in the best condition place their stems in water as soon as they are cut. They are kept in a cool, dark underground room, subcellars being used in many establishments which make a specialty of growing for market. Thus filled with water, they will stand up longer and not wilt so quickly from loss of moisture by evaporation. This method of cooling is considered better than using ice, as the flowers keep better when not subjected to violent change of temperature from a refrigerator to an express car. They are usually cut when the temperature of the houses is not extremely high, morning being preferred to evening, since such flowers as roses are softer after hours of exposure to bright sunlight, and ripen during the night. In summer as little time as possible is lost in getting the flowers into market, while in cooler weather some are improved if kept twelve to twenty-four hours before being packed for shipment. Long shallow wooden boxes are smoothly lined with newspaper, above which sheets of thin oil paper are laid. The heads are usually placed at each end of the box, and in the case of very large chrysanthemums there are but one or two rows of blossoms, the stems being tied to the bottom of the box with raffia to hold them in place.

Roses are carefully laid in successive rows, an equal number at each end, and smaller stock, as mignonette and lily of the valley, in one direction, in even beds of bloom. The boxes are carefully strapped and sent by express. The companies allow special net rates and return the empty boxes without charge. At such stations as Madison, New Jersey, where floriculture is largely carried on, an extra car is provided specially for cut flowers.

Upon arrival at the railroad station in New York, the boxes are quickly transferred to wagons and driven to the Twenty-fourth Street entrance of the Cut Flower Company, where they are lifted to the receiving room on an immense elevator. Here they are at once opened, examined by an expert, and graded according to established rules. Roses, for example, are classed as fancy, extra, first, second, and third. American Beauty and American Belle are the only varieties which enter into the fancy class, a requisite being stems twenty-four inches and over. In the class known as extra, stems sixteen to twenty-four inches are specified for the same varieties, and for other varieties eighteen inches and over. Stems ten to sixteen inches long are required for first-class flowers of these two larger sorts, six to ten inches for second class, and less than six inches for third. In the same classes for all other roses the conditions for stems are twelve to eighteen inches, seven to twelve inches and less than seven inches.

From these general classifications for roses other than American Beauty and American Belle, there are special rules for particular varieties. The smaller growing sorts, as Niphetos, Papa Gontier, and Souvenir de Wootton, for instance, have a standard for shorter stems than such roses as Belle Siebrecht and Perle des Jardins, while yet longer stems are required for Bride, etc. But length of stem is by no means all that is required. Roses to be classed in the higher grades must have large, well-formed buds of good substance, clear, bright color, and be free from blemish; the stems be straight and stiff, and the foliage luxuriant and clean. An off-color Meteor rose, good in all other respects, would go into class three. If some specially fine flowers are received, which plainly rank above the regular classes, special prices are readily paid for them by dealers who are always ready to take choice stock. The best flowers always sell quickly, and there is never a surplus. Glut and consequent loss always occur in the lower grades.

Prices are revised at the beginning of each week, and changed when necessary, but this has only occurred four times since September 1. After the grading is done, a slip with the quantity and quality noted is placed to the credit of the shipper, and the stock is placed in a refrigerator kept at forty-five degrees, or at once exposed for sale in the large adjoining room. There are always standing orders from retail dealers, even in advance of their personal visits, for stock from day to day. One large table is used solely for the filling of advance orders. It is laid off in sections assigned to the best regular buyers, the spaces designated by a permanent card bearing the buyer's name, and stone jars hold the stock until the buyer comes for it. Not until after the regular store trade is supplied are sales made to the street venders. Some of these are Americans, not a few of them women of ability and character. The majority are, however, Greeks, shrewd buyers and sellers, too, and good manipulators, as an observing grower declared. These Greeks are born merchants, many of them men of wealth. Although they have occasional sharp rivalries which are sufficiently bitter to suggest the possible use of the stiletto, they shrewdly combine to get the good out of any exceptional market condition. They are scattered all over the city and rent many spaces inside the sidewalk line on busy thoroughfares, besides stands in other public places.

Special demands are made for notable weddings and for festal days, as Christmas and Easter. Recently one order embraced 4,000 carnations, 14,000 chrysanthemums, 10,000 roses, 400 strings of smilax, and as many more of asparagus; 4,500 sprays of lily of the valley, 2,000 Bermuda lilies and 100 cattleyas, and half as many again were bought from other sources for use on the same occasion. Of course, this was apart from the forest of palms and other decorative plants in pots. In preparation for supplying unusually large quantities at one time, the development of some flowers is retarded in the hothouses and that of others is hurried forward.

The loss on unsold flowers is equitably divided pro rata among consignors in the class in which it occurs. Quality is in no small degree determined by weather, soft and mussy stock coming in after muggy days. General high quality of the great masses of flowers seen here is remarkable, as is also their freshness. A much higher grade is demanded now by retail buyers than a half dozen years ago, and flowers sold on the streets are especially of better quality during the past three or four years. The choicest varieties and newest sorts are offered here, and fragrant blossoms are always in special request.

The first buyers come as early as seven o'clock in the morning. Flowers looking dewy and fresh have already been taken from the largest refrigerators used for this sort of storage in the country and displayed in the salesroom, and others continue to arrive. Of carnations, from 5,000 to 25,000 are handled in one day, as many more violets and lilies of the valley, and 40,000 roses. At six o'clock in the evening the receiving and selling is over, and the storing of the freshest flowers still unsold concludes the work of the day. It is pleasant to record the fact that any flowers left over are presented to the hospitals.—M. B. C., New York, in Garden and Forest.

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